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JRB Associates, Inc., McLean, VA

Prepared for

Environmental Protection Agency, Washington, DC

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16. ABSTRACT

This guidance document is intended to provide a more detailed structure for identifying, evaluating, and selecting remedial action alternatives under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (40 CFR 300). The feasibility study process begins with the development of specific alternatives based on general response actions identified in the remedial investigation to address site contamination problems. The alternatives are screened on the basis of public health and environmental concerns and order-of-magnitude costs. Alternatives that pass the screening process undergo detailed analyses to provide the decision-maker with information for selecting the alternative that is cost-effective. The detailed analyses encompasses engineering, institutional, public health, environmental, and cost analyses. Once the detailed analyses are conducted, the information is organized to compare findings of the evaluations for each alternative. A recommended format for the Feasibility Study Report is also provided. It describes the specific elements to be included, the rationale for their inclusions, the level of detail, and the documentation that should accompany the report.

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and

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and
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This document provides guidance for the preparation of feasibility studies required under the revised National Contingency Plan.

FOREWORD

Under the authorities of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), the Office of Emergency and Remdial Response and the Office of Waste Programs Enforcement are responsible for overseeing the development and implementation of the Government's program for response to uncontrolled releases of hazardous substances. These responses ensure that threats to public health, welfare, or the environment are appropriately addressed through the effective management of CERCLA's enforcement and funding authorities. The Hazardous Waste Engineering Laboratory develops new and improved technologies and systems to prevent, treat, and manage hazardous waste pollutant discharges to minimize the adverse economic, social, health, and aesthetic effects of pollution.

This document is a cooperative effort between the Office of Solid Waste and Emergency Response and the Office of Research and Development. It is one of a series of reports being published to implement CERCLA, otherwise known as Superfund. These reports provide an array of information necessary for compilance with the National Contingency Plan (NCP, 47 FR 31180, July 16, 1982), including: guidance for remedial investigation and feasibility studies, guidance for exposure assessments, analytical and engineering methods and procedures, research reports, technical manuals, toxicological and engineering data bases, and other reference documents pertinent to Superfund.

This guidance document provides guidance for the preparation of feasibility studies required under the revised NCP. It provides project managers and decision makers in government and industry with guidelines for developing and evaluating alternative remedial responses to be uncontrolled releases of hazardous substances. In conjunction with other publications in this series, it will assist in meeting the national goal of adequately protecting public health, welfare, and the environment.

ABSTRACT

This guidance document is intended to provide a more detailed structure for identifying, evaluating, and selecting remedial action alternatives under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (40 CFR 300).

The feasibility study process begins with the development of specific alternatives based on general response actions identified in the remedial investigation to address site contamination problems. Technologies within the categories are screened for their technical applicability to the site. Technologies considered technically appropriate are then combined to form alternatives that fulfill five specific categories. The alternatives are screened on the basis of public health and environmental concerns and order-of-magnitude costs.

Alternatives that pass the screening process undergo detailed analyses to provide the decisionmaker with information for selecting the alternative that is cost-effective. The detailed analyses encompasses engineering, institutional, public health, environmental, and cost analyses. The engineering analysis evaluates constructability and reliability to ensure the implementability of alternatives. The institutional analysis examines alternatives in terms of the Federal, State, or local requirements, advisories, or guidance that must be considered to protect the public health, welfare, and environment. The public health exposure evaluation includes baseline site evaluation, exposure assessment, standards analysis, short- and long-term effects of each alternative, and endangerment assessment. The environmental analysis includes assessment of adverse impacts if no action is taken and the short- and long-term effects of the alternatives. The cost analysis examines capital and operation costs, and involves present worth and sensitivity analyses.

Once the detailed analyses are conducted, the information is organized to compare findings of the evaluations for each alternative. The objective of this summary is to ensure that important information is presented in a concise format so that the decisionmaker can choose the remedy that provides the best balance of health and environmental protection, and engineering reliability with cost.

A recommended format for the Feasibility Study Report is also provided. It describes the specific elements to be included, the rationale for their inclusions, the level of detail, and the documentation that should accompany the report.

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CHAPTER 1

EXECUTIVE SUMMARY

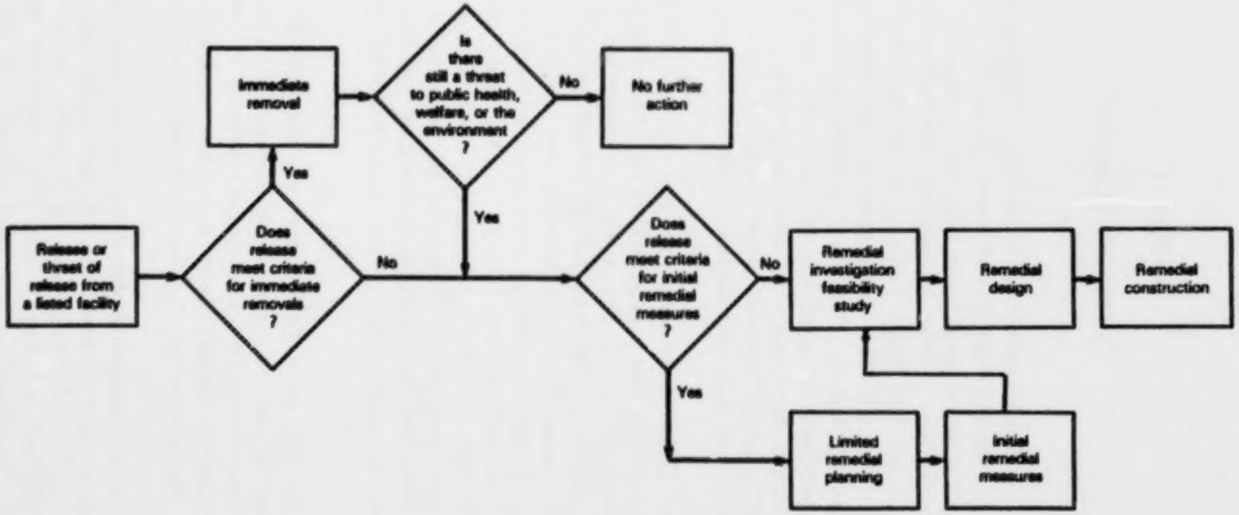
The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) establishes a national program for responding to releases of hazardous substances into the environment. The funding mechanism for this program is the Hazardous Substance Response Trust Fund (commonly referred to as the Superfund), which provides funding for the studies of such releases and the development and implementation of removal and remedial response actions. The operational centerpiece of this program, that ensures the Superfund is used as effectively as possible for these purposes, is the revised National Oil and Hazardous Substances Contingency Plan (NCP), originally promulgated under section 311 of the Federal Water Pollution Control Act and revised under section 105 of CERCLA.

Executive Order 12316 delegates to the U.S. Environmental Protection Agency (EPA) the authority and responsibility for management of the Superfund and implementation of the site response program. In accordance with section 105 of CERCLA, EPA has established procedures for reporting releases, evaluating remedies, determining the appropriate extent of response, and assuring that remedies are cost-effective; and has incorporated these procedures in the NCP (47 FR 31180, July 16, 1982; 40 CFR 300) as Subpart F (40 CFR 300.61-300.71). Additional amendments were proposed on February 12, 1985, and are anticipated to be published after the publication of this document. Many of the proposed changes in the revised NCP that relate to conducting an RI/FS have been incorporated into this guidance document.

Subpart F of the NCP sets forth the process by which remedial actions will be evaluated and selected, shown in Figure 1-1, and the factors to be considered in this process under the requirements of section 105. Response to and action to minimize damage from hazardous substances releases must, to the greatest extent practicable, be in accordance with the NCP.

The purpose of this guidance document is to provide a more detailed analytical structure to the framework for identifying, evaluating, and selecting remedial action alternatives put forth in the NCP. This guidance should be used by Federal and State Remedial Project Managers and their contractors, who are responsible for developing and preparing supporting documentation for remedial actions performed under CERCLA. Additionally, this guidance should be used by Federal, State, and private hazardous waste management officials developing remedial actions at sites where enforcement actions are taken, or for which claims against the Fund are to be presented.

Figure 1-1. Current NCP Process


Release or threat of release from a listed facility
Does release meet criteria for immediate removals ?
Yes
Immediate removal
Is there still a threat to public health, welfare, or the environment ?
No
No further action
Yes
No
Does release meet criteria for initial remedial measures ?
No
Remedial investigation feasibility study
Remedial design
Remedial construction
Yes
Limited remedial planning
Initial remedial measures

It is important to note that, while this document provides analytical guidance to the user, it does not provide guidance on the overall management of the remedial process, nor does it provide specific guidance on the best analytical techniques to use on a site-by-site basis. Management guidance is provided in separate EPA/State participation, enforcement, and contract management guidance documents. Technical guidance documents that may be useful in conducting specific analyses are available or forthcoming. These documents are discussed further at the end of this chapter.

1.1 THE NATIONAL CONTINGENCY PLAN FRAMEWORK FOR THE REMEDIAL RESPONSE PROCESS

The NCP sets forth a five step remedial response process:

1. Site discovery or notification: A release of hazardous substances, pollutants, or contaminants identified by Federal, State, local government agencies, or private parties is reported to the National Response Center (NRC). Upon discovery, such potential sites are screened to identify release situations warranting further remedial response consideration. These sites are entered into the Emergency and Remedial Response Inventory System (ERRIS); this computerized system serves as a data base of site information and tracks the change in status of a site through the remedial response process.

2. Preliminary assessment and site inspection (PA/SI): The preliminary assessment involves the collection and review of all available information and may include off-site reconnaissance to evaluate the source and nature of hazardous substances present and to identify the responsible party(s). Depending on the results of the PA, a site may be referred for further action. Site inspections routinely include the collection of samples and are conducted to determine the extent of the problem and to obtain information needed to determine whether a removal action is needed at the site or whether the site should be included on the National Priorities List (NPL).

3. Establishing priorities for remedial action: Sites are scored using the Hazard Ranking System (HRS) and the data from the PA/SI. This scoring process is the primary mechanism for identifying sites to be included in the National Priorities List (NPL), which in turn is the guide for allocating Superfund monies for cleanups. Sites that receive a score of 28.5 or greater will be proposed as candidates for the NPL. After public comment, these sites may be included on the NPL.

4. Remedial investigation/feasibility study (RI/FS): Site investigations are conducted to obtain information needed to identify, select, and evaluate remedial action alternatives in the feasibility study based on technological, public health, institutional,

cost, and environmental factors. The final result of this step is selection of the most appropriate, cost-effective solution. In some cases, the RI may show that no further action is needed.

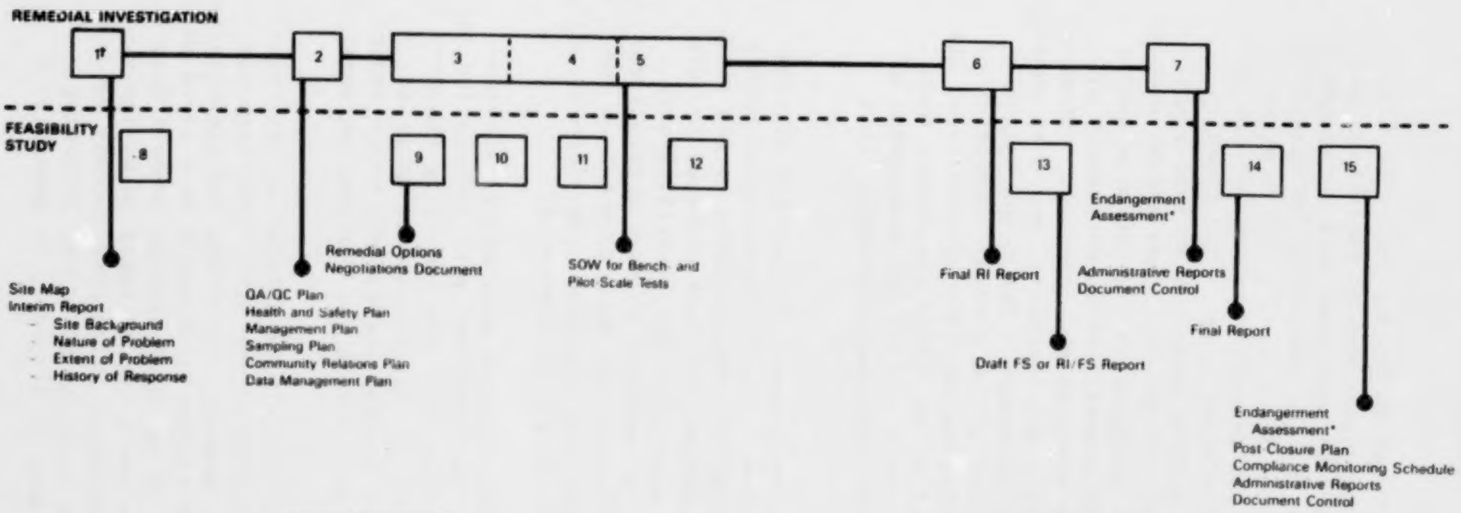
5. Remedial action design and construction: The actual design of the selected remedial action is developed then implemented through construction.

Under step 4 above, the NCP requires that the need for appropriate response actions must be identified in the project scoping stage, prior to planning the RI, in order to establish a basis for RI and FS funding. The information from the preliminary assessment, site inspection, or other sources is used to determine the general types of response actions applicable to the site for use in planning the RI. The NCP also requires that a detailed remedial investigation and feasibility study be conducted for the sites that are listed on the National Priorities List (section 105 of CERCLA) and targetted for remedial response under section 104 of CERCLA in order to obtain the data necessary to define the problem and evaluate and select alternative remedial measures. The remedial investigation (RI--for which separate guidance has been developed) provides site characterization data that serve as the basis for development of the feasibility study (FS). In the FS, alternative remedial actions are developed and evaluated in terms of cost, engineering implementation and constructability, the extent to which each alternative provides protection to public health and the environment, and environmental impacts during or remaining after implementation. Remedies that are developed and implemented by private parties under CERCLA must also be consistent with the NCP.

The feasibility study and remedial investigation are interdependent. The activities comprising these two projects are generally performed concurrently rather than sequentially. The remedial investigation emphasizes data collection and site characterization while the feasibility study emphasizes data analysis and evaluation of alternatives. Because of the complex nature of many sites, however, new site characterization information may be developed as the RI progresses that requires reassessment of the general types of response actions identified, with the possible addition of other types of responses. In turn, this may require expanding the remedial investigation to develop the data necessary to evaluate the new alternatives.

Figure 1-2 presents a flow chart of the RI/FS process, illustrating the interdependence and concurrence of tasks performed in the remedial investigation and feasibility study. The numbers identifying the tasks (boxes) in the flow chart are keyed to the tasks in the model contract statements of work for remedial investigations and feasibility studies, and are tabulated under the flow charts. (EPA's model statement of work for feasibility studies is provided in Appendix A of this document.) Chapters of this document and its companion document, the "Remedial Investigation Guidance Document," which provides guidance for performing the respective tasks are identified in this figure by task. Additionally, the figure shows milestones and identifies specific reports which may be required.

Figure 1-2. RI/FS Process


REMEDIAL INVESTIGATION
FEASIBILITY STUDY
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14
15
Site Map
Interim Report
- Site Background
- Nature of Problem
- Extent of Problem
- History of Response
QA/QC Plan
Health and Safety Plan
Management Plan
Sampling Plan
Community Relations Plan
Data Management Plan
Remedial Options
Negotiations Document
SOW for Bench- and
Pilot Scale Tests
Final RI Report
Draft FS or RI/FS Report
Endangerment
Assessment*
Administrative Reports
Document Control
Final Report
Endangerment
Assessment*
Post Closure Plan
Compliance Monitoring Schedule
Administrative Reports
Document Control

Remedial Investigation

Model Statement of Work for Remedial Investigations	Guidance Document for Remedial Investigations Under CERCLA
	CH 1 - Introduction
Task #1 - Description of Current Situation	CH 2 - Scoping
	CH 3 - Sampling Plan Development
Task #2 - Plans & Management	CH 4 - Data Management Procedures
	CH 5 - Health and Safety Planning for Remedial Investigations
Task #3 - Site Investigation	CH 6 - Institutional Issues
Task #4 - Site Investigation Analysis	CH 7 - Site Characterization
Task #5 - Laboratory & Bench Scale Studies	CH 8 - Pilot and Bench Studies
Task #6 - Reports	
Task #7 - Community Relations Support	CH 9 - Remedial Investigation Report Format

Feasibility Study

Model Statement of Work for Feasibility Studies	Guidance Document for Feasibility Studies Under CERCLA
	CH 1 - Executive Summary
Task #8 - Description of Proposed Response	CH 2 - Develop a Range of Remedial Alternatives
Task #9 - Preliminary Remedial Technologies	
Task #10 - Development of Alternatives	CH 3 - Conduct a Detailed Technical Evaluation
Task #11 - Initial Screening of Alternatives	CH 4 - Evaluate Institutional Requirements
	CH 5 - Evaluate Protection of Public Health Requirements
Task #12 - Evaluation of Alternatives	CH 6 - Evaluate Environmental Impacts
	CH 7 - Cost Analysis
Task #13 - Preliminary Report	CH 8 - Summarize Alternatives
Task #14 - Final Report	
Task #15 - Additional Requirements	CH 9 - Feasibility Study Report Format

† Numbers in the boxes refer to tasks described in the Model Statement of Work for RI/FS under CERCLA Guidance issued February 1985. See Appendix A.

* Endangerment assessments may be prepared at any point in the RI/FS process in support of enforcement actions.

1.2 AN OVERVIEW OF THE FEASIBILITY STUDY PROCESS

The feasibility study process is outlined in Figure 1-3. The first step of the feasibility study, defining the objectives of the action and broadly developing response actions, should be performed as a refinement to project scoping during the remedial investigation and should be summarized in the final remedial investigation report. There may be modification of this scoping as data are collected or as the general response actions are more fully developed during the feasibility study stage. The remedial alternatives developed at this point are general response actions which broadly define the nature of the response. In general, they should address whether source control measures (measures designed to prevent or minimize migration of hazardous substances from the source) and/or management of migration measures[1] (measures designed to mitigate the impact of contamination that has migrated into the environment) are necessary, and what phasing of these measures (operable units) may be necessary. The terms "source control" and "management of migration" refer to two general categories of response actions that are useful for developing specific alternatives. The term "on-site response actions" in the policy on CERCLA compliance with other environmental laws refers to both source control and management of migration measures. These requirements are discussed throughout this document.

The next step in the process is the development of specific alternatives within the general response categories. First, technologies within the categories are screened for their technical applicability to the site. Technologies considered technically appropriate are then combined to form operable units that address one or more aspects of the identified site problems. These operable units may then be combined to form alternatives addressing the complete site. The alternatives are then screened on the basis of public health, environmental, and cost concerns. Development and screening of alternatives is discussed in detail in chapter 2.

The next five activities comprise the detailed analysis of alternatives, which is necessary to provide the decisionmaker with information for selecting the alternative that is cost-effective. The remaining chapters of this guidance document provide a framework for developing the necessary analysis for making this selection. Each chapter discusses a major aspect of the feasibility study process. Chapter 3 covers the engineering analysis

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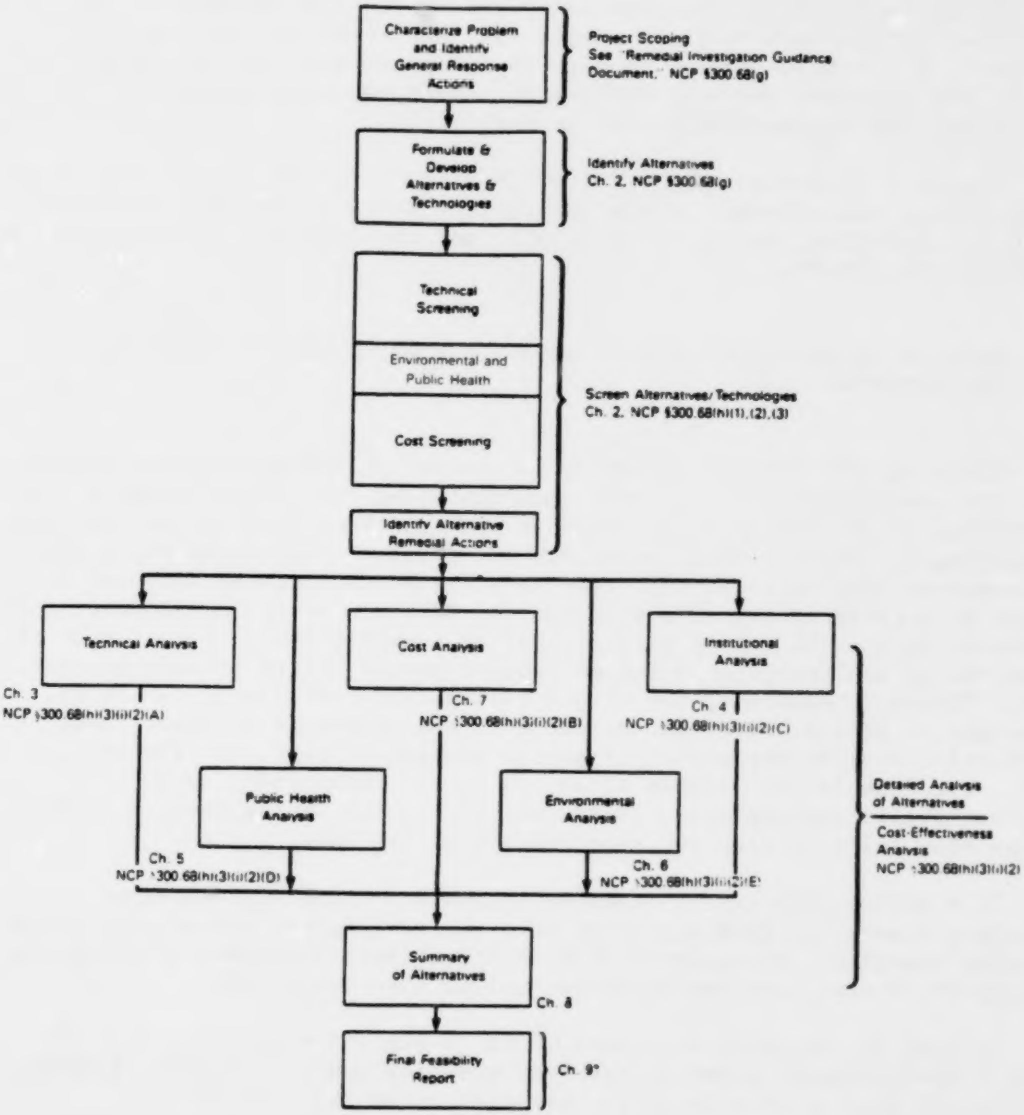
[1] Management of migration measures have previously been known as "off-site" measures, as defined in section 300.68(e)(3) of the NCP. This term has been changed to avoid confusion between measures involving the minimization or mitigation of migration of wastes or contaminants which have moved away from the source, and off-site disposal of wastes following removal from a site. Management of migration measures are measures taken to mitigate or minimize the further migration of contaminants which have already moved from the source. Off-site treatment or disposal of wastes following removal, referred to as off-site treatment or disposal, is generally a source control measure.

Figure 1-3. Feasibility Study Process


Characterize Problem and Identify General Response Actions
Project Scoping
See "Remedial Investigation Guidance Document," NCP §300.68(g)
Formulate & Develop Alternatives & Technologies
Identify Alternatives
Ch. 2, NCP §300.68(g)
Technical Screening
Environmental and Public Health
Cost Screening
Screen Alternatives/Technologies
Ch. 2, NCP §300.68(h)(1),(2),(3)
Identify Alternative Remedial Actions
Technical Analysis
Ch. 3
NCP §300.68(h)(3)(i)(2)(A)
Cost Analysis
Ch. 7
NCP §300.68(h)(3)(i)(2)(B)
Institutional Analysis
Ch. 4
NCP §300.68(h)(3)(i)(2)(C)
Public Health Analysis
Ch. 5
NCP §300.68(h)(3)(i)(2)(D)
Environmental Analysis
Ch. 6
NCP §300.68(h)(3)(i)(2)(E)
Detailed Analysis of Alternatives
Cost-Effectiveness Analysis
NCP §300.68(h)(3)(i)(2)
Summary of Alternatives
Ch. 8
Final Feasibility Report
Ch. 9*

Note: NCP sections identified refer to those cited in the Federal Register, July 16, 1982.

*Not specified sections of the NCP

of the alternatives in terms of constructability and reliability to ensure the implementability of alternatives. Chapter 4 covers the institutional analysis of alternatives in terms of the Federal, State, or local standards, advisories, or guidance that must be attained or considered to protect the public health, welfare, and environment. Chapter 5 covers public health exposure evaluation, and chapter 6 covers the environmental analysis of alternatives. The evaluation of the costs of alternatives is discussed in chapter 7. Chapter 8 provides guidance on how to organize and summarize the information developed in analyses described in previous chapters. The objective of this summary is to ensure that important information is presented in a concise format so that the decisionmaker can choose the remedy that provides the best balance of health and environmental protection, and engineering reliability with cost.

Chapter 9 discusses the format of the report for the feasibility study. It identifies the elements of the feasibility study report, the rationale for their inclusion, the level of detail, and the documentation necessary to accompany the report.

1.3 REMEDIAL ALTERNATIVES MUST ADDRESS THE REQUIREMENTS OF OTHER ENVIRONMENTAL LAWS

EPA's current policy, regarding compliance of CERCLA response actions with the requirements of other environmental laws, is to give primary consideration to the selection of those response actions that are effective in preventing or, where prevention is not practicable, minimizing the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health, welfare, or the environment. As a general rule, this can be accomplished by pursuing remedies that meet the standards of applicable or relevant Federal public health or environmental laws. However, because of the unique circumstances at particular sites, there may be alternatives that do not meet the standards of other laws, but which still provide protection of public health, welfare, and the environment. For example, at certain sites, it may be technically impractical, environmentally unacceptable, or excessively costly to implement a response action that fully attains the requirements of the laws.

This policy effectively examines response actions which prevent hazardous substances from migrating into the environment and actions which minimize migration, recognizing that CERCLA primarily addresses inadequate past disposal practices and resultant unique site conditions.

On-site source control or management of migration measures will not require environmental permits; however, off-site waste treatment, storage, or disposal must be at a facility permitted under the appropriate environmental law. However, this requirement does not prohibit a State or local authority from fulfilling their respective permitting requirements. The application of this policy in developing and selecting remedies at

Superfund sites is discussed in subsequent chapters. EPA has also included requirements of this policy in the proposed revisions to the NCP.

1.4 THE PROCESS APPLIES TO ENFORCEMENT ACTIONS

Enforcement actions must follow the same analytical steps for developing and evaluating remedial actions as Federal- and State-lead, Fund-financed actions. Additionally, to support enforcement case preparation, regional and State project managers and their contractors may be required to prepare endangerment assessments and remedial options negotiations documents. Basically, these documents characterize the threat to public health and the environment posed by the site and the alternatives for mitigating that threat.

Chapter 10 (forthcoming) discusses in greater detail enforcement actions and necessary support documentation. The chapter identifies the procedures governing potential responsible party (PRP) participation in the development of the RI/FS. The chapter highlights stages of PRP participation in an RI/FS that are unique from an enforcement perspective. The chapter also addresses the differences between PRP and Fund-financed RI/FS.

1.5 SUPPLEMENTAL GUIDANCE DOCUMENTS UNDER DEVELOPMENT

The user should be aware of additional policy, management, and technical guidance that may affect the conduct of the FS. Some of the most important of these include:

- "Procedures for Planning and Implementing Off-Site Response Actions"
- "Agency Policy on CERCLA Compliance with other Environmental Laws"
- "Guidance for Remedial Investigations under CERCLA"
- "Methodology for Screening and Evaluation of Remedial Responses"
- Surface Cleanup Guidance for Drums, Tanks, and Lagoons
- Guidance for Alternative Water Supply
- "Remedial Action Costing Procedures Manual"
- "Compendium of Costs for Remedial Technologies"
- "Superfund Public Health Procedures"
- "Health Effects Assessment Documents"
- "Superfund Exposure Assessment Manual"
- "Endangerment Assessment Guidance"
- "User's Guide to the Contract Laboratory Program"

- "State Participation in the Superfund Remedial Program"
- "Community Relations in Superfund: A Handbook."

While many of these documents are available, several are currently in preparation and will be forthcoming.

CHAPTER 2

DEVELOP A RANGE OF REMEDIAL ALTERNATIVES

The National Oil and Hazardous Substances Contingency Plan (NCP) outlines a process for identifying, developing, and evaluating remedial action alternatives for a given site. The process begins with project scoping, discussed in chapter 2 of the EPA's "Remedial Investigation Guidance Document." As part of project scoping, general response actions to remedy known problems at the site are identified (based upon existing data) as a basis for planning the Remedial Investigation and Feasibility Study. Remedial response actions fall into three general categories: initial remedial measures[1], source control, and management of migration. NCP project scoping requirements are specified in NCP Section 300.68(d)[2], which states in part:

> (d) The lead agency, in cooperation with the State(s), will examine available information and determine...the type or types of remedial response that may be needed to remedy the release. This scoping will serve as the basis for requesting funding for a remedial investigation and feasibility study....

With additional site-specific data from the remedial investigation, remedial alternatives within the general response categories are developed and evaluated. As a result of the investigation, it may be determined that additional general response actions are needed.

The development and evaluation of remedial alternatives then proceeds in three phases. First, a limited number of alternatives are developed. Second, an initial screening of these alternatives reduces them to a workable number. Third, a limited number of remedial alternatives, based on those that have passed the initial screening, are analyzed in detail. Section 300.68(g), (h), and (i)[2] of the NCP outlines this process:

> (g) Development of Alternatives. A limited number of alternatives should be developed for either source control or [management of

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[1] The proposed revisions to the NCP eliminate initial remedial measures as a remedial response category. Response actions conducted previously as initial remedial measures will, in the future, be considered removal actions, source control measures, or management of migration measures.

[2] Federal Register, Vol. 47, No. 137, July 16, 1982.

migration] (or both) depending upon the type of response that has been identified...as being appropriate.

(h) Initial Screening of Alternatives. The alternatives developed... will be subjected to an initial screening to narrow the list of potential remedial actions for further detailed analysis.

(i) Detailed Analysis of Alternatives. (1) A more detailed evaluation will be conducted of the limited number of alternatives that remain after the initial screening....

This chapter is a guide to the first two phases of this process. Chapters 3 through 7 of this document provide guidance on the third phase, the detailed analysis of alternatives.

2.1 OVERALL APPROACH

The recommended alternative development and screening procedure (Figure 2-1) consists of six steps.

Identify General Response Actions

1. Identify site problems and pathways of contamination (remedial investigation)[3].

2. Identify general response actions that address site problems and meet cleanup goals and objectives.

Identify and Screen Technologies and Develop Remedial Alternatives

3. Identify possible technologies in each general response action, then screen the technologies to eliminate inapplicable and infeasible technologies based on site conditions.

4. Assemble technologies into operable units based on the remaining feasible technologies.

Screen Public Health, Environmental, and Cost Factors

5. Screen alternatives, eliminating those that have significant adverse impacts or that obviously do not adequately protect the environment, public health, and public welfare.

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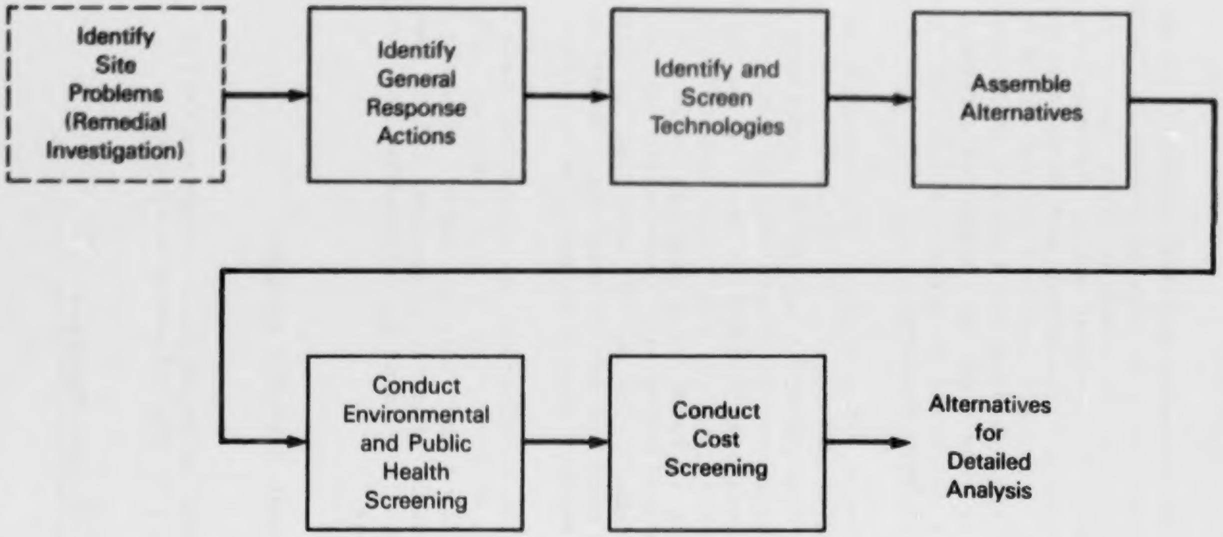
[3] Detailed guidance for identifying pathways is forthcoming in the Public Health Procedures Manual.

Figure 2-1. Feasibility Study Alternative Development and Screening Process


Identify Site Problems (Remedial Investigation)
Identify General Response Actions
Identify and Screen Technologies
Assemble Alternatives
Conduct Environmental and Public Health Screening
Conduct Cost Screening
Alternatives for Detailed Analysis

6. Screen alternatives, eliminating those that are an order of magnitude higher in cost than other alternatives but do not provide significantly greater environmental or public health benefits or technical reliability.

Developing and screening remedial alternatives is actually a repetitive process that may take place at several points in the RI/FS process. The process may begin during the remedial investigation to define the field data requirements of specific remedial action alternatives. As more site data are collected, existing alternatives may be rescreened, or additional alternatives developed to reflect improved understanding of the site. Screening may also occur during the detailed analysis of alternatives if it is decided that an alternative should not be considered further, based upon the screening criteria discussed in steps 5 and 6 (the reasons for such a decision must be clearly documented).

Each study should, at a minimum, include each of the six elements, although some studies may require modifications of this process to meet site conditions. Each feasibility study should concisely summarize the results of each step, as explained in chapter 9. In some circumstances, especially if the site is undergoing remediation pursuant to enforcement actions, an interim report identifying the remaining remedial alternatives may be prepared. This report is known as a Remedial Options Negotiation Document and supports Agency negotiations with responsible parties by identifying appropriate remedial technologies and alternatives for site cleanup, considering any previous site work and any in progress. Normally, regional enforcement personnel decide whether such a document is required.

The alternative development and screening steps described in the following sections of this chapter are presented rather formally, but the process is generally a more informal matter of using established engineering practices. The formal process, summarized below, need not be followed rigidly, but it should be used as a framework for documenting the initial screening decisions.

2.2 IDENTIFY GENERAL RESPONSE ACTIONS

The development of remedial alternatives (steps 1 through 4 above), is described in detail in the following sections.

2.2.1 Identify Site Problems

The user should identify alternatives that address all significant site problems and pathways of contamination identified during the remedial investigation. Site problems can generally be placed in one or more of the following categories: (1) air pollution; (2) surface water infiltration or contamination; (3) leachate generation and contaminated ground water; (4) gas migration; (5) presence of wastes in drums, lagoons, etc.; (6)

contaminated sediments and soils; and (7) contaminated water supply and sewer lines.

The information needed to identify the site problem is usually gathered during the preliminary assessment and the site inspection and summarized in the initial scoping of the remedial investigation. The EPA manual "Methodology for Screening and Evaluation of Remedial Responses"[4] presents sample site problems, with their associated classes of remedial responses, as part of a recommended approach to technology selection and screening.

2.2.2 Identify General Response Actions

Based on site information from the remedial investigation, the user should identify general response actions, or classes of response without necessarily identifying specific technologies. General response actions considered should include the "no action" alternative as a baseline against which other measures can be measured. Examples of general response actions include the following:

- No action[5]
- Containment
- Pumping
  - On-site
  - Off-site
- Collection
- Diversion
- Complete removal
- Partial removal
- On-site treatment
- In situ treatment
- Storage
- On-site disposal
- Off-site disposal
- Alternative drinking water supply
- Relocation of receptors
- Other off-site measures.

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[4] In preparation.

[5] The "no action" alternative does not preclude removal action under the CERCLA removal program.

2.3 IDENTIFY AND SCREEN TECHNOLOGIES

The user should identify feasible technologies for each general response action identified, recognizing that there may be compatible and incompatible combinations of source control and management of migration measures. Table 2-1 is a partial list of technologies appropriate to the general response actions described above. Some technologies should be modified or eliminated, such as those that may prove extremely difficult to implement, may not achieve the remedial objective in a reasonable time, or may rely on unproven technology.

Table 2-2 is a comprehensive list of remedial technologies classified according to the kinds of site problems they are intended to mitigate. For technologies that can be used in various configurations, several "function options" are also given. Similarly, where different materials may be used in the same technology, "materials options" are provided. The user should refer to the EPA "Handbook for Remedial Action at Waste Disposal Sites" (June 1982) for a more comprehensive description of these technologies. During technology screening, the use of this list will help ensure that all remedial technologies are considered. The list should be updated periodically to incorporate newly developed technologies.

The user should review site data to identify conditions that may limit or promote the use of certain remedial technologies. Such information is generally gathered during the site investigation or remedial investigation. Table 2-3 identifies site characteristics that should be evaluated as part of the screening process. Technologies whose use is clearly precluded by site characteristics should be eliminated from consideration.

The user should also identify waste characteristics that limit the effectiveness or feasibility of the remedial technologies. Such characteristics include: (1) physical properties such as volatility, solubility, and density; (2) specific chemical constituents such as chlorinated organic chemicals or metals; and (3) properties that determine the waste's toxicity or degree of hazard, such as persistence, acute toxicity, and ignitability. Table 2-4 presents waste characteristics that may influence the feasibility and effectiveness of remedial actions. Technologies clearly limited by waste characteristics should be eliminated from consideration.

The user should also identify the level of technology development, performance record, and inherent construction, operation, and maintenance problems of each technology considered. Technologies that are unreliable, perform poorly, or are not fully demonstrated should be eliminated. Limitations of various remedial technologies are discussed in the EPA "Handbook for Remedial Action at Waste Disposal Sites" (June 1982) and other documents listed in the bibliography.

The user may wish to use a previously developed methodology that presents feasible remedial technologies and their limiting waste, site, and technology characteristics. The EPA manual "Methodology for Screening and

TABLE 2-1. GENERAL RESPONSE ACTIONS AND ASSOCIATED REMEDIAL TECHNOLOGIES

General Response Action	Technologies
No Action	Some monitoring and analyses may be performed.
Containment	Capping; ground water containment barrier walls; bulkheads; gas barriers.
Pumping	Ground water pumping; liquid removal; dredging.
Collection	Sedimentation basins; French drains; gas vents; gas collection systems.
Diversion	Grading; dikes and berms; stream diversion ditches; trenches; terraces and benches; chutes and downpipes; levees; seepage basins.
Complete Removal	Tanks; drums; soils; sediments; liquid wastes; contaminated structures; sewers and water pipes.
Partial Removal	Tanks; drums; soils; sediments; liquid wastes.
On-site Treatment	Incineration; solidification; land treatment; biological, chemical, and physical treatment.
Off-site Treatment	Incineration; biological, chemical, and physical treatment.
In Situ Treatment	Permeable treatment beds; bioreclamation; soil flushing; neutralization; land farming.
Storage	Temporary storage structures.
On-site Disposal	Landfills; land application.
Off-site Disposal	Landfills; surface impoundments; land application.
Alternative Water Supply	Cisterns; aboveground tanks; deeper or upgradient wells; municipal water system; relocation of intake structure; individual treatment devices.
Relocation	Relocate residents temporarily or permanently.

TABLE 2-2. REMEDIAL TECHNOLOGIES

A. Air Pollution Controls

- Capping
  - Synthetic membranes
  - Clay
  - Asphalt
  - Multimedia cap
  - Concrete
  - Chemical sealants/stabilizers
- Dust Control Measures
  - Polymers
  - Water

B. Surface Water Controls

- Capping (see A.)
- Grading
  - Scarification
  - Tracking
  - Contour furrowing
- Revegetation
  - Grasses
  - Legumes
  - Shrubs
  - Trees, conifers
  - Trees, hardwoods
- Diversion and Collection Systems
  - Dikes and berms
  - Ditches and trenches
  - Terraces and benches
  - Chutes and downpipes
  - Seepage basins
  - Sedimentation basins and ponds

(continued)

TABLE 2-2. (continued)

- Levees
- Addition of freeboard
- Floodwalls

C. Leachate and Ground Water Controls

- Capping (see A.)

- Containment barriers

  Function options

  - Downgradient placement
  - Upgradient placement
  - Circumferential placement

  Material and construction options (vertical barriers)

  - Soil-bentonite slurry wall
  - Cement-bentonite slurry wall
  - Vibrating beam
  - Grout curtains
  - Steel sheet piling

  Horizontal barriers (bottom sealing)

  - Block displacement
  - Grout injection

- Ground water pumping (generally used with capping and treatment)

  Function options

  - Extraction and injection
  - Extraction alone
  - Injection alone

  Equipment and Material Options

  - Well points
  - Deep wells

(continued)

TABLE 2-2. (continued)

  - Suction wells
  - Ejector wells

- Subsurface Collection Drains

  - French drains
  - Tile drains
  - Pipe drains (dual media drains)

D. Gas Migration Controls (generally used with treatment)

- Capping (gas barriers) (see A.)

- Gas collection and/or recovery

  - Passive pipe vents
  - Passive trench vents
  - Active gas collection systems

E. Excavation and Removal of Waste and Soil

- Excavation and removal

  - Backhoe
  - Cranes and attachments
  - Front end loaders
  - Scrapers
  - Pumps
  - Industrial vacuums
  - Drum grapplers
  - Forklifts and attachments

- Grading (see B.)

- Capping (see A.)

- Revegetation (see B.)

F. Removal and Containment of Contaminated Sediments

- Sediment removal

(continued)

TABLE 2-2. (continued)

Mechanical dredging

- Clamshell
- Dragline
- Backhoe

Hydraulic dredging

- Plain suction
- Cutterhead
- Dustpan

Pneumatic dredging

- Airlift
- Pneuma
- Oozer

- Sediment turbidity controls and containment

  - Curtain barriers
  - Coffer dams
  - Pneumatic barriers
  - Capping

G. In Situ Treatment

- Hydrolysis
- Oxidation
- Reduction
- Soil aeration
- Solvent flushing
- Neutralization
- Polymerization
- Sulfide precipitation
- Bioreclamation
- Permeable treatment beds
- Chemical dechlorination

(continued)

TABLE 2-2. (continued)

H. Direct Waste Treatment

- Incineration

  - Rotary kiln
  - Fluidized bed
  - Multiple hearth
  - Liquid injection
  - Molten salt
  - High temperature fluid wall
  - Plasma arc pyrolysis
  - Cement kiln
  - Pyrolysis/starved combustion
  - Wet air oxidation
  - Industrial boiler or furnace

- Gaseous waste treatment

  - Activated carbon
  - Flares
  - Afterburners

- Treatment of aqueous and liquid waste streams

  Biological treatment

  - Activated sludge
  - Trickling filters
  - Aerated lagoons
  - Waste stabilization ponds
  - Rotating biological disks
  - Fluidized bed bioreactors

  Chemical treatment

  - Neutralization
  - Precipitation
  - Oxidation
  - Hydrolysis
  - Reduction
  - Chemical dechlorination
  - Ultraviolet/ozonation

(continued)

TABLE 2-2. (continued)

Physical treatment

- Flow equalization
- Flocculation
- Sedimentation
- Activated carbon
- Kleensorb
- Ion exchange
- Reverse osmosis
- Liquid-liquid extraction
- Oil-water separator
- Steam distillation
- Air stripping
- Steam stripping
- Filtration
- Dissolved air flotation

Discharge to a publicy owned treatment works

- Solids handling and treatment

Dewatering

- Screens, hydraulic classifiers, scalpers
- Centrifuges
- Gravity thickening
- Flocculation, sedimentation
- Belt filter presses
- Filter presses
- Drying or dewatering beds
- Vacuum-assisted drying beds

Treatment

- Neutralization
- Solvent
- Oxidation
- Reduction
- Composting

- Solidification, stabilization, or fixation

  - Cement-based

(continued)

TABLE 2-2. (continued)

  - Lime-based
  - Thermoplastic
  - Organic polymer
  - Self-cementing techniques
  - Surface encapsulation
  - Glassification
  - Solidification (i.e., to fly ash, polymers, sawdust)

I. Land Disposal Storage

- Landfills
- Surface impoundments
- Land application
- Waste piles
- Deep well injection
- Temporary storage

J. Contaminated Water Supplies and Sewer Lines

- In situ cleaning

- Removal and replacement

- Alternative drinking water supplies

  - Cisterns or tanks
  - Deeper or upgradient wells
  - Municipal water systems
  - Relocation of intake

- Individual treatment units

TABLE 2-3. SITE CHARACTERISTICS THAT MAY AFFECT REMEDIAL TECHNOLOGY SELECTION

Site volume
Site area
Site configuration
Disposal methods
Climate (precipitation, temperature, evaporation)
Soil texture and permeability
Soil moisture
Slope
Drainage
Vegetation
Depth of bedrock
Depth to aquicludes
Degree of contamination
Direction and rate of ground water flow
Receptors
Drinking water wells
Surface waters
Ecological areas
Existing land use
Depths of ground water or plume

TABLE 2-4. WASTE CHARACTERISTICS THAT MAY AFFECT REMEDIAL TECHNOLOGY SELECTION

Quantity/concentration
Chemical composition
Acute toxicity
Persistence
Biodegradability
Radioactivity
Ignitability
Reactivity/corrosivity
Infectiousness
Solubility
Volatility
Density
Partition coefficient
Compatibility with other chemicals
Treatability

Evaluation of Remedial Responses"[6] presents one such approach, with screening tables showing site, waste, and technology limitations for remedial alternatives under each general class. The manual also has a checklist for tracking technologies not excluded by the limitations given in the tables. This and similar methodologies, however, should serve only as guides for screening. They cannot substitute for acceptable engineering practice in screening technologies.

The user should give special consideration to technologies that permanently contain, immobilize, destroy, or recycle contaminants, and technologies that promote energy recovery. Also, certain technologies often are used in combination, and the user should have a working knowledge of those technologies. EPA is currently drafting guidance for the consideration of these technologies.

2.4 DEVELOP ALTERNATIVES BY COMBINING TECHNOLOGIES

Technologies that have passed the technology screening can be used to form more definite alternatives.

In developing remedial alternatives, the user should rely on acceptable engineering practice to determine which of the screened technologies appear most suitable for the site. Consideration should be given to recycle, reuse, waste minimization, destruction, or other advanced, innovative, or alternative technologies, if appropriate. The user should document the reasons for excluding technologies that passed the technology screening. The user should also consider relevant and applicable standards listed in Table 5-2 in selecting and combining technologies into alternatives to achieve specific cleanup goals.

As part of the feasibility study (FS), at least one alternative for each of the following must, at a minimum, be evaluated within the requirements of the feasibility study guidance and presented to the decisionmaker (the FS report should discuss those situations where no feasible alternative can be identified for a given category):

(a) Alternatives for treatment or disposal at an off-site facility approved by EPA (including RCRA, TSCA, CWA, CAA, MPRSA, and SDWA approved facilities), as appropriate;[7]

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[6] In preparation.

[7] These alternatives must be consistent with EPA Policy "Procedures for Planning and Implementing Off-Site Response Actions" (see Appendix B). In some cases, off-site disposal or treatment may not be feasible and this alternative may be eliminated during initial screening of alternatives. The decision documents should reflect this screening.

(b) Alternatives which attain applicable and relevant Federal public health or environmental standards;

(c) As appropriate, alternatives which exceed applicable and relevant public health or environmental standards;

(d) Alternatives which do not attain applicable or relevant public health or environmental standards but will reduce the likelihood of present or future threat from the hazardous substances. This must include an alternative which closely approaches the level of protection provided by the applicable or relevant standards and meets CERCLA's objective of adequately protecting public health, welfare, and environment.

(e) A no action alternative.

Since ground water contamination is the most frequent type of problem at NPL sites, the corrective action requirements of Subpart F of the RCRA regulations (40 CFR Part 264) will be applicable or relevant in many cases and should be included in alternatives developed under category (b). Under the RCRA regulations, corrective actions must attain a ground water cleanup standard established for each facility. For a limited number of potential contaminants, a standard is specified in the regulations at levels corresponding to National Interim Primary Drinking Water Standards developed pursuant to the Safe Drinking Water Act. An alternate concentration limit (ACL) may be established for any contaminant upon a determination that the ACL will "not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration limit is not exceeded" [40 CFR 264.94(b)]. In the absence of an ACL or a standard based on Safe Drinking Water Act determinations, the ground water protection standard is background. The RI/FS should examine whether an ACL is appropriate at each site where the Subpart F regulations are applicable or relevant.

Generally, ACLs can be based on a demonstration that there is a lack of exposure or that levels of exposure are adequate to protect human health. In considering ACLs, it is appropriate to consider attenuation, degradation, and dilution of the contaminants before they reach possible receptors. Engineering approaches can be used to augment natural dilution and attenuation processes. Additionally, institutional controls to assure that ground water within the current or probable reach of the plume of contamination will not be withdrawn, or will be withdrawn only at points at which contaminants are at concentrations that are safe, may be considered as a basis for controlling exposure. In conjunction with the controls described above, there may be limited circumstances where treatment of the water before use can be guaranteed as a means of preventing exposure to harmful levels. The decision criterion is in all cases, however, whether an alternate concentration level will pose a substantial hazard to human health or the environment. Alternatives that do not meet the RCRA Subpart F requirements for background MCLs or ACLs but significantly reduce public health threats (for example engineering controls to attenuate or dilute concentrations to acceptable levels at the receptor point) should be presented in category (d).

Since the RCRA ground-water protection program is relatively new, experience to date in implementing alternate concentration limits is limited. Needed additional guidance is being prepared for Regional use. This guidance will discuss factors and conditions that may be used in evaluating alternate concentration limits.

In some cases, there may be some overlap between the alternatives developed. A single alternative may fit more than one category, and several alternatives may be developed for each category. Furthermore, alternatives may be developed that, through changes in the design, fit more than one of the categories. For example, an alternative that attains applicable or relevant Federal standards [category (b)] may fall in category (c) through relatively minor design or operation modifications.

The development of alternatives is closely related to the institutional review process discussed in chapter 4. The user should refer to chapter 4 for appropriate institutional requirements that must be considered when developing remedial alternatives.

The alternatives developed must also be re-evaluated during the public health evaluation dicussed in chapter 5, specifically, after completion of the exposure assessment (section 5.3) and comparison of environmental concentrations to applicable and relevant standards (section 5.4). Alternatives in categories (b) and (c) above may need to be modified if different pathways or exposure concerns are identified.

The NCP specifies that remedial alternatives, besides filling each of the categories, should be classified either as source control [40 CFR 300.68(e)(2)] or off-site (management of migration) remedial actions [40 CFR 300.68(e)(3)]. The distinction significantly affects the level of detail necessary in evaluating remedies. Source control remedial actions address situations in which hazardous substances remain at or near the areas in which they were originally located and are not adequately contained to prevent migration into the environment. Off-site remedial actions address situations in which the hazardous substances have largely migrated from their original locations. Off-site actions are now referred to as management of migration actions, to distinguish actions involving management of migration from those involving hazardous substance removal and disposal in off-site facilities. Alternatives developed may fall solely in either classification or may involve a combination of source control and management of migration measures, as determined by the specific site problems addressed.

2.4.1 Source Control Remedies

The purpose of source control remedies is to prevent or minimize migration of hazardous substances from the source material. These remedies may be applied to situations in which contaminants are in the soil, a lagoon, or a pond. The extent and route of the release and/or the threat of release must be documented to justify specific source control measures.

Source control measures seek to completely remove, stabilize, and/or contain the hazardous substances. Source control measures may be used in many situations where they will curtail further risk to humans or the environment. In these cases, only a limited public health assessment may be necessary in selecting a cost-effective remedy.

Where preventing migration appears infeasible, measures that will reduce future migration from the source should be considered. In these cases, a more extensive analysis will be necessary to select a cost-effective remedy that adequately protects public health. Chapters 5 and 6 address the considerations involved in these analyses. In such situations, management of migration measures should be considered in conjunction with source control measures.

Where a source control alternative involves off-site treatment [an alternative in category (a)], destruction, or disposal of wastes following removal, section 300.70(c) of the NCP requires that EPA determine that this alternative is either "(1) more cost-effective than other remedial actions; (2) will create new [waste management] capacity...; or (3) is necessary to protect [human health and the environment]...." To aid in this evaluation, the user must, in those instances where an off-site transport, treatment, storage, or disposal alternative is among the list of response actions, include a comparable on-site alternative for evaluation. For example, when off-site disposal at a landfill approved under RCRA is among the alternatives to be evaluated, construction of such a landfill on the site should be evaluated as well.

2.4.2 Management of Migration Remedies

Management of migration remedial actions are necessary where hazardous substances have migrated from the original source of contamination and pose a significant threat to public health, welfare, or the environment; for example, where contamination exceeds relevant and applicable public health or environmental standards, guidance, and advisories. Any management of migration measure that adequately protects public health, welfare, and the environment (by reducing contaminant levels) should be considered for implementation. Particular consideration should be given to technologies that permanently contain, immobilize, destroy, or recycle contaminants.

An example of a site at which management of migration action may be appropriate would be one at which a contaminated ground water plume has moved downgradient from the site, beyond site boundaries, and is threatening private drinking water wells. At such a site, management of migration measures such as aquifer pumping and treatment may be appropriate.

Management of migration alternatives may also involve measures that prevent or minimize impacts through means such as substitution. An example of such an alternative would be provision of an alternative drinking water source in cases where ground water contamination threatens private wells.

2.5 SCREEN ALTERNATIVES FOR PUBLIC HEALTH, ENVIRONMENTAL, AND COST FACTORS

The next step involves screening of remedial alternatives based on environmental and public health criteria, followed by an "order of magnitude" cost screening. This two-step screening permits an initial assessment of the applicability of each alternative relative to the others.

This process eliminates alternatives that do not provide adequate protection of public health, welfare, and the environment, and those that are much more costly than others without providing significantly greater protection. When alternatives are eliminated from further consideration, the feasibility study must document the rationale for excluding each alternative.

In some situations, screening may eliminate all alternatives in one of the five categories listed above under Section 2.4, "Develop Alternatives by Combining Technologies." When this occurs, at least one alternative for the category that was eliminated must be included in the summary of alternatives presentation described in chapter 8 and should be presented to the decisionmaker with an explanation as to why it was eliminated at the screening stage.

2.5.1 Environmental and Public Health Screening

The user should identify adverse impacts on the environment or on public health and welfare that may preclude the use of each assembled alternative. Alternatives that may have significant adverse impacts or do not adequately protect the environment and public health should be eliminated. At this point, adequate protection should be thought of as a comprehensive response that addresses all pathways and points of exposure. The user should identify alternatives that provide similar environmental and public health and welfare benefits in preparation for the cost screening.

2.5.2 Cost Screening Factors

The object of the cost screening is to eliminate alternatives that have costs an order of magnitude greater than those of other alternatives but do not provide greater environmental or public health benefits or greater reliability.

In preparing cost estimates for screening, certain limiting factors should be considered to control the level of effort expended in compiling the estimates. These factors include accessibility of data sources, the time available, and the degree of accuracy to be achieved. The following guidelines are recommended for use when defining the level of effort in cost screening:

- Data sources should be limited to the "Remedial Actions Cost Compendium" (ELI, 1984), Handbook: Remedial Action at Waste Disposal Sites (U.S. EPA, 1982), the remedial investigation (for revising design assumptions where necessary), standard costs indices, and other readily available information.
- The time for preparing screening cost estimates should be limited to a few days.
- The objective in calculating the costs is to achieve an accuracy within -50 to +100 percent.

Cost screening should be undertaken for all remedial alternatives remaining from the public health and environmental screening. The cost screening can be divided into three basic tasks: (1) estimation of costs, (2) present worth analysis, and (3) cost screening evaluation.

2.5.2.1 Estimation of Costs

Remedial alternatives are screened on the basis of both capital costs and operating and maintenance costs. These costs should reflect site-specific conditions and should be revised using the cost compendium (ELI, 1984) or other standard cost guidance references.

Capital costs should include the following:

- Relocation costs
- Costs of land acquisition or obtaining permanent easements
- Land and site development costs
- Costs of buildings and services
- Equipment costs
- Replacement costs
- Disposal costs
- Engineering expenses
- Construction expenses
- State and local legal fees, licenses, and permit costs
- Contingency allowances
- Startup and shake-down costs
- Costs of anticipated health and safety requirements during construction.

Care should be taken to ensure that all applicable cost components are considered in the capital cost estimate.

Operation and maintenance costs should include, where applicable, the following:

- Operating labor costs
- Maintenance materials and labor costs
- Costs of auxiliary materials and energy
- Purchased service costs
- Administrative costs
- Insurance, taxes, and licensing costs
- A maintenance reserve and contingency fund.

Care should be taken to ensure that all of these cost components are considered. Vendor quotes are not generally available at this stage of the analysis, because technical information and time are limited. Since site- and remedy-specific factors determine the degree to which each category of cost is required at a given site, it will be useful for the cost analyst to develop a checklist of site- and remedy-specific cost considerations before attempting the cost estimate. Such cost considerations are suggested in the "Remedial Actions Cost Compendium" (ELI, 1984). If necessary, cost estimates should be updated to current values using standard cost indices. Procedures for updating cost estimates are discussed in chapter 7.

2.5.2.2 Present Worth Analysis

After developing screening cost data, the user must determine the present worth of both the capital and other expenditures. Discounting to present worth is necessary when operation and maintenance costs are anticipated for one or more alternatives. Present worth (or present value) analysis enables the user to compare sets of costs by computing the current value of all costs incurred, whether they are incurred in the present or at some future date. The present worth analysis conducted during screening relies on less refined cost data but is otherwise identical to the present worth analysis conducted during detailed cost estimation. This analysis should be based on the OMB-prescribed 10 percent discount rate. However, a quick calculation of alternative discount rates may be desirable (e.g., 4 or 7 percent) to observe sensitivity of overall estimates to discount rates. This check is most useful in cases that involve future replacement costs. The procedures for conducting a present worth analysis are discussed in detail in the EPA "Costing Procedures Manual."[8]

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[8] In preparation.

In some cases, wastes removed from a site, such as fuel oils or other hydrocarbons, may be recoverable. In such cases, revenues from the sale of removed materials should be considered in the present worth analysis.

2.5.2.3 Cost Screening Evaluation

The user should compare present worth costs of competing alternatives with similar environmental, public health, and public welfare benefits. Alternatives should be eliminated if they are deemed much more expensive (an order of magnitude or more) and offer similar or smaller environmental and public health benefits but no greater reliability than competing alternatives. Alternatives that are more expensive but offer substantially greater environmental and/or health benefits should not be eliminated.

CHAPTER 3

CONDUCT A DETAILED TECHNICAL EVALUATION

One of the first concerns in the detailed analysis of alternatives is that suggested technologies are appropriate to site conditions. Section 300.68(i)[1] of the National Oil and Hazardous Substances Contingency Plan (NCP) requires the following:

> (i) Detailed Analysis of Alternatives
>
> (1) A more detailed evaluation will be conducted of the limited number of alternatives that remain after the initial screening....
>
> (2) The detailed analysis of each alternative should include:
>
> (A) Refinement and specification of alternatives in detail, with emphasis on the use of established technology....
>
> (C) Evaluation in terms of engineering implementation, or constructability....
>
> (E) An analysis of...methods for mitigating [adverse environmental] impacts....

Each remedial alternative is evaluated for performance, reliability, implementability, and safety. EPA's publication "Methodology for Screening and Evaluation of Remedial Responses,"[2] the Army Corps of Engineers' Engineer Manual "Preliminary Guidelines for Selection and Design of Remedial Systems for Uncontrolled Hazardous Waste Sites" (EC 1110-2-244), and the EPA "Handbook for Remedial Action at Waste Disposal Sites" (1982) provide useful information. The resulting estimates of alternatives' technical feasibility are included in the summary of alternatives discussed in chapter 8. The elements of technical feasibility are discussed, and a suggested format for summarizing these evaluations is presented in the remainder of this chapter.

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[1] Federal Register, Vol. 47, No. 137, July 16, 1982.

[2] In preparation.

3.1 PERFORMANCE

Two aspects of remedial actions determine their desirability on the basis of performance: effectiveness and useful life. Effectiveness refers to the degree to which an action will prevent or minimize substantial danger to public health, welfare, or the environment. The useful life is the length of time this level of effectiveness can be maintained.

3.1.1 Effectiveness

Remedial alternatives should be evaluated in terms of their ability to perform intended functions, such as containment, diversion, removal, destruction, or treatment. The effectiveness of alternatives should be determined either through design specifications or by performance evaluation. These two methods are discussed further below and in chapter 5 with respect to evaluations of public health protection.

The user should establish which environmental and public health standards are relevant or applicable at the site and evaluate proposed alternatives according to those standards. In evaluating alternatives, the user may institute changes that improve them. Relevant and applicable standards and guidelines for use in performing these evaluations are presented in chapter 5, the public health section, and chapter 6, the environmental chapter. Response alternatives should use these standards developed by other EPA programs as design and/or performance specifications, or consider appropriate criteria and guidance. If such criteria are substantially adjusted (e.g., for risk level or exposure factors), the basis for the adjustment must be clearly stated (see chapters 4 and 5).

Any special site or waste conditions that affect performance should be considered, and the design should be tailored to accommodate those conditions. The evaluation should also consider the effectiveness of combinations of technologies. Specifications should be based on ASTM, AASHTO, or other appropriate engineering standards, if applicable.

Standards, criteria, or guidance are not available for all situations at hazardous waste sites; in these cases, performance specifications based on acceptable engineering practice must be developed and used in evaluating alternatives. The user should give preference to those technologies that completely immobilize, destroy, or recycle the hazardous material, or promote energy recovery.

The evaluation of on-site alternatives should include an analysis of locational factors that could impact effectiveness. These factors include:

- Ground-water considerations such as aquifer classification (see section 4.3)
- Floodplain impacts

- Seismic, landslide, subsidence, or volcanic impacts
- Site geology (for example, is the site underlain by fractured bedrock or karst topography).

These factors should be considered to determine if on-site alternatives can be effective. Engineering modifications may be necessary to mitigate adverse locational impacts, if appropriate.

3.1.2 Useful Life

Most remedial technologies, with the possible exception of destruction, deteriorate with time. Often, deterioration can be slowed through proper operation and maintenance, but the technology eventually may require replacement. Each alternative should be evaluated in terms of the projected service lives of its component technologies. Resource availability in the future life of the technology, as well as the appropriateness of the technologies, must be considered in estimating the useful life of the project.

3.2 RELIABILITY

The cost of installing and operating remedial alternatives and the importance of protecting public health and the environment make reliability a serious concern. Two aspects of remedial technologies that provide information about reliability are their operation and maintenance requirements and their demonstrated reliability at similar sites.

3.2.1 Operation and Maintenance Requirements

Evaluations of the operation and maintenance requirements of remedial alternatives should emphasize the availability of labor and materials as well as their costs. Also, the frequency and complexity of necessary operation and maintenance should be considered in evaluating the reliability of alternatives. Technologies requiring frequent or complex operation and maintenance activities should be regarded as less reliable than technologies requiring little or straightforward operation and maintenance.

3.2.2 Demonstrated Performance

The technical analysis of remedial alternatives should not be based on the presumed performance of untested methods. An estimate of the probability of failure, in either qualitative or quantitative terms, should be made for each component technology and for the complete alternative. The user should give preference to technologies that have proven effective under waste and site conditions similar to those anticipated. However, innovative or advanced technology should be evaluated as an alternative to conventional technology, if appropriate. Sometimes bench-scale studies will be necessary to determine actual performance characteristics; these studies may be part of the remedial investigation or the design phase.

As more experience is gained in applying and developing remedial technologies, a broader range of activities will have demonstrated performance. At present, many technologies are still in the research and development stages. If such developmental technologies are included in suggested remedial alternatives, the user should be certain to include information from researchers supporting its use and evaluating its expected reliability.

3.3 IMPLEMENTABILITY

Another important aspect of remedial alternatives is their implementability--the relative ease of installation and the time required to achieve a given level of response. Ease of installation, often known as constructability, is determined by conditions both internal and external to the site. The time requirements can be generally classified as the time required to implement a technology and the time required before results are actually realized.

3.3.1 Constructability

3.3.1.1 Site Conditions

The constructability of remedial technologies under actual site conditions is fundamental to the technical analysis of alternatives. The ability to actually build, construct, or implement the remedial technology on the site must be assessed.

3.3.1.2 Conditions External to the Site

Conditions external to the site that affect the implementability of remedial technologies include the availability and acceptability of off-site disposal sites and the equipment available for construction.

Certain remedial activities may require zoning clearances and local permits in addition to compliance with applicable State and Federal regulations. Chapter 4 discusses some of these statutes in more detail. In addition, the public acceptability of the alternative can be of fundamental importance in determining the implementability of the action.

3.3.2 Time

The time element of remedial efforts is an important aspect of site remedial planning. Emphasis should be on quickly eliminating exposure to hazardous substances. Two measures of time that should be addressed are the time it takes to implement a remedy and the time it takes to realize beneficial effects. The importance of timing depends on the nature of the hazard; speed is most important at sites presenting immediate, rather than long-term, hazards.

3.3.2.1 Time to Implement

Implementation time includes the time it takes for special studies, design, construction, and any other technical steps that may be required for implementation. Implementation time estimates should take account of weather conditions, unanticipated site conditions, and necessary safety precautions. The user should evaluate alternatives in terms of the most likely construction schedule, based on experience at similar sites or on a standard engineering procedure like critical path analysis.

3.3.2.2 Time to Achieve Beneficial Results

Some remedial alternatives achieve instantaneous results (e.g., surface cleanup or the provision of alternative water supplies). Often, though, considerable time is required from the beginning of construction until the desired results are achieved. During this period, ancillary measures, such as the temporary provision of alternative potable water supplies or temporary relocation, are commonly taken to mitigate the threat. The user should evaluate each alternative in terms of the time it takes to see beneficial results in the environment, exclusive of measures that provide temporary protection. Beneficial results should be defined as the reduction in levels of contamination necessary to attain or exceed relevant or applicable standards. RCRA standards for corrective action require meeting background MCLs or ACLs within a reasonable period of time. While no specific length of time has been specified, the U.S. EPA Office of Solid Waste considers several years to be reasonable, depending on specific site conditions. Where no applicable or relevant standards are available, the user should consult headquarters on a case-by-case basis for further guidance; final guidance is under development for such situations.

3.4 SAFETY

Each remedial alternative should be evaluated with regard to safety. This evaluation should include short-term and long-term threats to the safety of nearby communities and environments as well as those to workers during implementation. Major risks to consider are fire, explosion, and exposure to hazardous substances resulting due to both on-site and off-site activities during remedial action implementation.

The joint guidelines of the EPA, the Occupational Safety and Health Administration (OSHA), and the National Institute for Occupational Safety and Health (NIOSH), or the Corps of Engineers guidance, prepared to ensure the health and safety of workers at uncontrolled hazardous waste sites, may be used to determine the risk to worker health and safety during implementation. Alternatives should be designed to minimize risk during construction and should be evaluated in terms of such safety.

3.5 SUMMARY OF TECHNICAL FEASIBILITY ANALYSIS

Table 3-1 will help the user evaluate alternatives based on performance, reliability, implementability, and safety. The user should assess site conditions that affect constructability and set design and/or siting criteria for successful construction.

The user should explicitly evaluate the technical characteristics of the components of the alternative as well as those of the entire alternative; measures that aggregate many factors cannot be used effectively in distinguishing between alternatives with similar general characteristics.

In Table 3-1, alternatives are listed in the left column. Each alternative is described in terms of its component technologies, indicated for example by "A-1", "A-2", and so on, of alternative "A." For example, alternative "A" may consist of site capping, diversion ditches, a slurry wall, ground-water pumping, and treatment of the effluent. The user should describe the absolute degree to which each alternative or technology meets each criterion. In addition, the user may also describe the alternatives and technologies in order of their relative desirability with respect to each criterion. The user should provide a consistent description of any outstanding features that render the technology particularly desirable or any limitations that may hinder its use for remedial action at the site. Where possible, quantitative descriptions should be provided so that absolute incremental differences in the alternatives can be discerned.

TABLE 3-1. SUMMARY OF TECHNICAL FEASIBILITY EVALUATION

Remedial Alternative	Criterion			
	Performance		Reliability	
Remedial Alternatives	Effectiveness	Useful Life	Operation and Maintenance Requirements	Possible Failure Modes
A				
A-1				
A-2				
A-3				
A-4				
A-5				
Remarks: Alternative A summary				
B				
B-1				
B-2				
B-3				
Remarks: Alternative B summary				
C				
C-1				
C-2				
C-3				
C-4				
Remarks: Alternative C summary				

(continued)

TABLE 3-1. (continued)

	Implementability			
	Constructability		Time	
	Site Conditions	Conditions External to Site	To Implement	To See Desired Results
A				
A-1				
A-2				
A-3				
A-4				
A-5				
Remarks: Alternative A summary				
B				
B-1				
B-2				
B-3				
Remarks: Alternative B summary				
C				
C-1				
C-2				
C-3				
C-4				
Remarks: Alternative C summary				

(continued)

TABLE 3-1. (continued)

	Safety Considerations	
	Worker Health and Safety	Neighboring Facilities & Communities
A		
A-1		
A-2		
A-3		
A-4		
A-5		
Remarks: Alternative A summary		
B		
B-1		
B-2		
B-3		
Remarks: Alternative B summary		
C		
C-1		
C-2		
C-3		
C-4		
Remarks: Alternative C summary		

CHAPTER 4

EVALUATE INSTITUTIONAL REQUIREMENTS

This chapter describes current EPA policy on the use of applicable and relevant standards and other criteria, guidance, and advisories at Superfund remedial sites. The user should be aware that this policy is subject to change[1] and further interpretation with regard to specific standards, and should consult supplemental policy and program guidance documents that will be issued as this policy is developed. If any questions about specific applications of this policy arise, the user should consult EPA headquarters.

This chapter also discusses other institutional issues in analyzing remedial alternatives, such as coordination with other Federal agencies and community relations.

4.1 OVERVIEW OF INSTITUTIONAL REQUIREMENTS

It is EPA policy that, in selecting remedial actions, primary consideration be given to remedies that attain applicable or relevant Federal environmental and public health standards. State and local standards should be considered; however, State standards that are more stringent than Federal standards may form the basis for a remedy only if the result is consistent with the cost-effective remedy based on Federal standards. (The State will generally be required to pay for the additional cost where more restrictive State standards are used.) EPA does not require that environmental permits be obtained for Fund-financed or enforcement actions taken at a site pursuant to sections 104 or 106 of CERCLA. However, States and private parties are not precluded from obtaining permits. In contrast, all off-site removal, treatment, storage, or disposal actions must be in compliance with other environmental laws, including permit requirements.

The user should evaluate the effects of Federal, State, and local standards and other institutional considerations on the design, operation, and timing of each alternative. In general, it is expected that regulatory programs under the Resource Conservation and Recovery Act (RCRA), the Safe

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[1] This chapter reflects a policy on the applicability of other environmental programs to actions under CERCLA. This policy is subject to the final rulemaking of the proposed amendments to the NCP, and this chapter is therefore presented as interim guidance.

Drinking Water Act (SDWA), and the Federal Water Pollution Control Act (Clean Water Act or CWA), will have the broadest applications to remedial action alternatives.

Results of the institutional analysis of each remedial alternative are to be presented, in tabular or narrative form, in the feasibility study as part of the noncost criteria analysis of the remedial action alternatives (see chapter 9). All applicable or relevant public health and environmental standards, interagency coordination needs, and other institutional issues should be identified.

This chapter is not intended to serve in lieu of regulations and policies implementing particular statutory requirements. The user should consult the appropriate regulations and policies to determine these requirements.

4.2 CERCLA COMPLIANCE WITH OTHER ENVIRONMENTAL STATUTES

EPA policy on the use of environmental and public health standards at Superfund sites is under development. The draft policy discussed in this chapter is outlined in the EPA policy memorandum "CERCLA Compliance with the Requirements of Other Environmental Statutes" (Appendix C). The key requirements of this policy have been incorporated in the proposed revisions to the National Oil and Hazardous Substances Contingency Plan (NCP).

It is EPA policy to comply with "applicable or relevant" environmental and public health standards in CERCLA remedial actions unless one of five specific circumstances described in section 4.2.1 exists, and to document all analyses of these circumstances. Other regulations, advisories, and guidance may be considered in developing CERCLA remedies. Relevant portions may be used; if they are not used, the reasons for not using them must be stated in the decision documents. The memorandum defines "applicable" and "relevant" and includes a preliminary list of requirements that would be considered applicable or relevant, and a list of other requirements, advisories, and guidance that should be considered. The final section of this chapter summarizes, in table form, the requirements identified to date.

Permits are not required for on-site Fund-financed or enforcement actions taken under CERCLA. They are required for off-site disposal actions (those involving removal and treatment, disposal, or destruction of wastes in off-site facilities). Off-site actions and their permit requirements include, but are not limited to, the following:

- Injection into an underground formation requires an Underground Injection Control permit.
- Transportation of hazardous waste to an off-site treatment, storage, or disposal facility (TSDF) requires RCRA TSDF permits.

- Discharge of pollutants or contaminants from a point source into U.S. waters requires a National Pollutant Discharge Elimination System (NPDES) permit pursuant to CWA section 402.

- Disposal, treatment, or destruction of hazardous waste at sea requires permits under the Marine Protection Research and Sanctuaries Act (MPRSA).

- Discharge of pollutant contaminants into a publicly owned treatment works (POTW) may require permits issued by the local POTW.

- Emissions of pollutants to the air may require Clean Air Act (CAA) permits, depending on the substance emitted, its quantity, and the classification of the area.

The responsible party or State must obtain the appropriate permits or assure that they are obtained; State responsibilities will be specified in the contract or cooperative agreement.

As explained in chapter 2, the feasibility study must examine and present to the decisionmaker at least one alternative in each of the following categories, if feasible:

- Alternatives for treatment or disposal at an off-site facility approved by EPA (including RCRA, TSCA, MPRSA, CWA, CAA, and SDWA approved facilities), as appropriate[2] (for cost-effectiveness comparison purposes, this alternative must be compared to an on-site treatment or disposal alternative);

- Alternatives which attain applicable and relevant Federal public health or environmental standards;

- As appropriate, alternatives which exceed applicable or relevant public health or environmental standards;

- Alternatives which do not attain applicable or relevant public health or environmental standards but will reduce the likelihood of present or future threat from the hazardous substances. This must include an alternative which closely approaches the level of protection provided by the applicable or relevant standards and meets

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[2] These alternatives must be consistent with EPA's policy "Procedures for Planning and Implementing Off-Site Response Actions." In some cases, off-site disposal or treatment may not be feasible and this alternative may be eliminated during initial screening of alternatives. The decision documents should reflect this screening (see Appendix B).

CERCLA's objectives of adequately protecting public health, welfare, and environment.

- A no action alternative.

In some cases these alternatives may overlap.

4.2.1 Selection of Remedy

The decisionmaker will consider all of the alternatives arrayed in the feasibility study and will give primary consideration to remedies that attain or exceed applicable or relevant Federal public health and environmental standards. The decisionmaker may select an on-site alternative that does not attain applicable or relevant standards in one or more of the circumstances discussed below. A consideration in making this determination is the extent to which the standard was intended to apply to the specific conditions at the site. For example, the RCRA program was not intended to regulate a site consisting of 210 miles of roadside contaminated by indiscriminant disposal of PCB wastes, or one consisting of a river bed contaminated with hazardous substances. If the recommended alternative involves an EPA standard, guidance, or advisory beyond the direct requirements of CERCLA, the decisionmaker will ensure coordination with all affected EPA programs.

The following specific circumstances are those in which the decisionmaker may select an on-site alternative that does not comply fully with applicable or relevant standards:

1. The selected alternative is not the final remedy and will become part of a more comprehensive remedy;

2. All of the alternatives which meet applicable or relevant standards fall into one or more of the following categories:

   (i) Fund-balancing - for Fund-financed actions only; exercise the Fund-balancing provisions of CERCLA section 104(c)(4);

   (ii) Technical impracticability - it is technically impracticable from an engineering perspective to achieve the standard at the specific site in question;

   (iii) Unacceptable environmental impacts - All alternatives that attain or exceed standards would cause unacceptable damage to the environment; or,

3. Where the remedy is to be carried out pursuant to CERCLA section 106; the Hazardous Response Trust Fund is unavailable, or would not

be used; there is a strong public interest in expedited cleanup; and the litigation probably would not result in the desired remedy.

Where one of these situations is present, the decisionmaker may select an alternative which does not attain or exceed applicable or relevant public health or environmental standards. The basis for not meeting the standard must be fully documented and explained in the appropriate decision documents.

The Agency anticipates that most CERCLA remedial actions will attain or exceed applicable or relevant public health or environmental standards. However, where the specific circumstances discussed above preclude the selection of a remedy that attains standards, the decisionmaker will select the alternative that most closely approaches the level of protection provided by the applicable or relevant standard, considering the reasons for not meeting that standard.

EPA also will use public health and environmental criteria in developing appropriate remedial alternatives. If the decisionmaker determines that such criteria are relevant, but are not used in the selected remedial alternative, the decision documents will indicate the basis for not using the criteria. Where no relevant or applicable standards are available, the user should consult headquarters on a case-by-case basis for guidance. In general, headquarters will instruct the user to develop at least one option corresponding to a 10^{-6} risk level. In addition, reasonable alternatives corresponding to a 10^{-4} to 10^{-7} risk level should also be developed.

For Fund-financed actions, where State standards are part of the cost-effective remedy, the Fund will pay to attain those standards. Where the cost-effective remedy does not include those State standards, the State may pay the difference to attain them.

There may be situations in which the decisionmaker may select a remedy that exceeds a standard, rather than simply attaining it, if under the circumstances it is appropriate to select a more protective level. For example, a land disposal alternative may have a lower present worth than a treatment alternative, however, the treatment alternative may more effectively protect public health and the environment. This selection process must be determined on a site-specific basis.

State environmental standards, guidance, or advisories should also be addressed. States have an important role in developing remedial alternatives. If a State desires the selection of a remedial action that would incorporate State standards more stringent than Federal standards, the decisionmaker may select that remedy. Generally, the State is expected to pay any additional costs.[3]

Changes will also be made in the Superfund community relations program as part of this policy to ensure public involvement equivalent to that in other permitting programs. These modifications are discussed in section 4.6 below.

The CERCLA enforcement program will also enhance public participation, in the cases of both consent decrees and administrative orders, to substantial equivalence with that in Fund-financed actions. Furthermore, consent decrees and administrative orders will incorporate recordkeeping and monitoring requirements similar to those mandated by other environmental programs.

This policy applies only to response actions taken pursuant to the Fund-financed or enforcement provisions of CERCLA.

4.3 EPA GROUND-WATER PROTECTION STRATEGY

EPA has developed the Ground-Water Protection Strategy (GWPS) to help State and Federal agencies cope with ground-water problems and to improve the coherence and consistency of EPA programs dealing with ground water. The GWPS is not considered at this time to fall in the category of relevant or applicable standards, but it should be considered when deciding on remedial alternatives. The Agency is planning to incorporate provisions of the Ground-Water Protection Strategy into future regulatory amendments. At that time, those provisions may become relevant or applicable.

The GWPS has four elements, keyed to specific objectives:

1. Strengthening State ground-water programs: Funds will be set aside to support State ground-water program development and provide technical assistance to the States. Funds will be provided to the States, through existing grant programs, to support the development of overall State action plans or strategies; identify and remove legal and institutional impediments to comprehensive State management; develop general and source-specific ground-water programs; and create a data system to increase the accessibility and quality of information. EPA will continue to support a strong research program to assist both Federal and State protection efforts.

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[3] Not applicable to enforcement actions.

2. Treating unaddressed ground-water problems: EPA will identify, evaluate, and develop means of coping with unaddressed ground-water problems including leaking underground storage tanks and non-hazardous surface impoundments and landfills. The Agency will increase efforts to protect ground water from contamination by nitrates or pesticides. EPA will also prepare a ground-water monitoring strategy to facilitate the evaluation of ground-water contamination from all sources.

3. Creating a policy framework for EPA programs: EPA will adopt guidelines for consistency in ground-water protection programs. These guidelines will protect ground water for the highest present or potential beneficial use. The guidelines will use existing statutes to define an appropriate protection strategy for three classes of ground water:

   - Class 1, Special Ground Waters, includes those highly vulnerable to contamination and either irreplaceable or ecologically vital sources of drinking water.

   - Class 2, Current and Potential Sources of Drinking Water and Waters Having Other Beneficial Uses, includes all other ground waters currently used or potentially available for drinking water or other beneficial uses.

   - Class 3, Ground Water Not a Potential Source of Drinking Water and of Limited Beneficial Use, includes saline or otherwise contaminated ground waters beyond reasonable use for drinking water or other beneficial purposes. Ground water in Class 3 must not be connected to Class 1 or 2 ground water or to surface water in a way that would allow contaminants to migrate to these waters, with potential adverse effects on human health or the environment.

   The guidelines will be implemented by the development of specific requirements in each major program area. The resulting standards will be general and performance-oriented to allow flexibility for States in implementing EPA-delegated programs.

4. Strengthening EPA's internal ground-water organization: The Office of Ground-Water Protection has been established in the Office of Water to coordinate ground-water activities and to identify and develop ground-water policies and guidelines.

Regional responsibility for ground-water coordination resides in the Water Divisions. Functions of the regional programs include overseeing ground-water policy development, providing technical and institutional support to States, and coordinating regional ground-water program plans, state work programs, site assessments, and enforcement.

The GWPS will affect CERCLA remedial actions mainly through the ground-water protection guidelines and classification system. The classification of affected ground waters will not change the hazard ranking score of a site; however, sites where ground water that is contaminated or threatened with contamination is a current source of drinking water do score higher than those where ground water is not a current source. Ground-water classifications should be used to establish priorities for initiating remedial investigations. Also, the degree of cleanup or protection of groundwater resources to be achieved at CERCLA sites will generally be keyed to the classification of the affected or potentially affected ground waters. Therefore, the evaluation and selection of remedial alternatives will have to take account of the ground-water classification.

Remedial actions at sites that overlie Class 1 ground waters (Special Ground Waters) will be given high priority. Cleanups will be to drinking water standards or levels that protect human health. Cleanup beyond the site boundaries may also be necessary. Statutory factors (e.g., Fund-balancing) and the need to achieve rapid private party response may require occasional acceptance of lower levels of cleanup.

At sites that overlie Class 2 ground waters, the goal of CERCLA cleanups will be drinking water quality or Alternative Concentration Limits (ACLs) under RCRA upon a determination that the ACL will not pose substantial present or potential hazard to human health or the environment. In the absence of an ACL or a drinking water standard, the goal of cleanup is the background level. Modifications are more likely for potential drinking water supplies than for current supplies. Consequently, alternatives to ground-water cleanup and restoration may be appropriate. In such a case, the plume of contamination may be monitored and managed to prevent or mitigate its migration into a current source of drinking water or to avoid widespread damage. In certain situations involving current sources of drinking water, such as when technical feasibility is an issue, the cost-effective remedy may be to provide an alternative drinking water supply rather than restoring the contaminated aquifer.

For CERCLA sites that overlie ground waters not considered potential sources of drinking water and of limited beneficial use (Class 3 ground waters), CERCLA remedial actions will generally not involve ground-water cleanup. The priority of these sites for remedial action will be low in the absence of other hazards to human health and the environment (such as surface water contamination, fire, or explosion).

Criteria for ground-water classification have not yet been developed in detail. However, the classifications will be determined in conjunction with assessments of the extent of contamination for CERCLA cleanup actions on a site-specific basis. In many cases, the geologic and hydrologic information necessary to make this classification will have been gathered as part of the site investigation. Information collected by other Federal and State agencies may be used for classification. Therefore, during preparation of the feasibility study, the classification should be available for determining the level of protection to be achieved.

4.4 COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

Remedial actions taken pursuant to sections 104 and 106 of CERCLA are generally exempt from the NEPA requirement to prepare an Environmental Impact Statement (EIS), based on numerous court decisions holding that the Agency carries out the functional equivalent of a NEPA review in its permitting and regulatory activities. Under this exemption, the EPA is not obligated to comply with formal EIS procedures if two criteria are met. The first is that the authorizing statute (i.e., CERCLA) must provide substantive and procedural standards to ensure full and adequate consideration of environmental issues and alternatives. The second is that the public must be afforded an opportunity to participate in evaluating environmental factors and alternatives before a final decision is made.

Taking the following steps will ensure that Fund-financed remedial actions meet these criteria and achieve functional equivalence with EIS requirements:

1. The process for determining the extent of the remedy required by CERCLA section 105(3) and described in section 300.68 of the NCP must be followed. To meet the first criterion of NEPA functional equivalency, this process includes the necessary and appropriate investigation and analysis of environmental factors as they specifically relate to a Superfund site, and alternatives that are being considered to correct the situation.

2. To meet the second criterion, a meaningful opportunity for public comment on environmental issues must be provided before the final selection of a remedial alternative. To meet this requirement, EPA Regions must allow both the opportunity and adequate time for the public to review draft feasibility studies. This should be accomplished as part of the community relations program required at all Superfund response sites.

4.5 COORDINATION WITH OTHER AGENCIES

CERCLA, the NCP, and Executive Order 12316 delegate the authority to manage certain aspects of Superfund responses to several Federal agencies. For example, the Federal Emergency Management Agency (FEMA) is authorized to manage relocations. The Department of Health and Human Services (HHS) and the U.S. Army Corps of Engineers also are often called on to assist in remedial actions. These agencies can contribute useful advice during the remedial investigation and feasibility study and should be consulted. The United States Geological Survey (USGS) is not delegated any specific CERCLA response authority, but its technical knowledge of geological characteristics at sites can be valuable in evaluating remedial alternatives. If coordination is required for any remedial alternative, the feasibility study must indicate that the appropriate agency has been or will be contacted and that the needed coordination mechanism either is in place or can be developed.

4.5.1 Federal Emergency Management Agency

Permanent relocation of residences, businesses, and community facilities is included in the definition of remedy under CERCLA section 101(24). Permanent relocation may be undertaken as part of a remedial action if human health is in danger and if, alone or in combination with other measures, it would be cost-effective and environmentally preferable to other responses. Temporary relocation, including evacuation and temporary housing of threatened individuals not otherwise provided for, may also be undertaken as part of a remedial action (e.g., during cleanup at a CERCLA site to limit exposure or threat of exposure to a significant environmental hazard).

EPA and FEMA efforts must be coordinated when a remedial action includes relocation. Executive Order 12316 delegates to the Director of FEMA the authority to carry out relocation under CERCLA. A memorandum of understanding between EPA and FEMA is being developed to define the responsibilities of these agencies in such relocation actions. The memorandum, when approved by both agencies, will supplement this section with more detailed guidance on the roles of FEMA and EPA in relocation and procedures for initiating relocation actions.

The required coordination between the agencies may affect implementation of an alternative. Also, community interest in remedial alternatives that include relocation will be high. For remedial alternatives that include relocation, the feasibility study must indicate that FEMA has been or will be contacted and that the necessary coordination mechanism either is established or can be developed. During the feasibility study the user should evaluate the effect of relocation on implementation of the remedial alternatives.

4.5.2 Health and Human Services

The Department of Health and Human Services, through the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH), is responsible for monitoring the health of workers and citizens at or near Superfund sites and for ensuring adequate health care. In this capacity, HHS can contribute to the evaluation of remedial alternatives. For each alternative, NIOSH and ATSDR can provide advice on the procedures that would be required to conduct worker health and safety programs and ensure the health of the local community. Furthermore, HHS health and epidemiological studies may provide data useful in assessing health concerns. When the user determines that HHS expertise is required, he or she should contact the regional HHS representative to request NIOSH or ATSDR support.

A memorandum of understanding between EPA and HHS is being developed to define the responsibilities of each agency in responses pursuant to CERCLA. The memorandum, when approved by both agencies, will supplement this section with more detailed guidance on HHS involvement.

4.5.3 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers manages the technical work during the remedial design and construction phases of Federal-lead remedial actions. The Corps also helps EPA review State-lead projects to determine their suitability for bidding and construction.

The Corps benefits from early involvement in the remedial investigation and feasibility study by learning about site problems before a remedy is selected. The Corps also can contribute valuable technical assistance from the earliest stages. For example, the Corps may require certain data about the site for design and construction that may not be needed to evaluate and recommend remedial alternatives. Collecting such data during the remedial investigation is generally less costly than going back to the site after the remedy has been selected.

The Corps can also provide useful advice about the technical feasibility of the various remedial alternatives, ensuring that the alternative selected can be engineered and constructed. EPA will not assign a remedial action to the Corps for management if the Corps determines that the action is not reasonable to design, construct, operate, and maintain. In addition, the Corps can initiate the process of securing rights-of-way, thus reducing the delay between selection and implementation of an alternative.

The Corps' expertise may also be useful in cases in which Corps-administered permits are applicable (e.g., when the remedial action involves discharge of dredged or fill material). When the user determines that Corps advice is needed, he should contact the appropriate District Engineer.

The Corps may also be called upon to perform compliance monitoring of remedial construction activities of responsible parties under enforcement.

4.5.4 U.S. Geological Survey

The user may find it useful to consult with USGS district offices to gather basic technical information about a site. It is generally not appropriate to contract with USGS to perform the feasibility study in a Federal-lead remedial action. Instead, the USGS may be consulted as a formal contractor to the Remedial Planning and Field Investigation Team contractor or through an interagency agreement (agreements for this purpose already exist). In State-lead responses, it may be appropriate for the USGS to perform the feasibility study as a contractor to the State. EPA is currently exploring this issue to clarify the appropriate USGS role in Superfund responses.

Many States employ geologists who can provide useful technical information about sites in their States; they often can be contacted through State departments of natural resources. Using State geologists makes it possible to bypass any contractual difficulties or delays caused by the need for formal contracts with USGS. State geologists may be especially useful when the need for a geologist at a site is not great enough to warrant hiring a geologist full-time for an indefinite period. In any case, State geologists form a valuable resource that should not be overlooked.

4.5.5 Occupational Safety and Health Administration

While worker safety and health at Superfund response sites are the responsibility of employers, OSHA has the authority to inspect Superfund sites and issue citations for unsafe conditions. The OSHA health response team is available to provide technical assistance to regional project managers, OSCs, and contractors in appropriate safety procedures. Note that some States operate their own occupational safety and health programs in place of OSHA, and that some working conditions are covered by Federal agencies other than OSHA (such as the Mining Safety and Health Administration). These other agencies could have jurisdiction in some CERCLA response actions for specific working conditions.

4.5.6 National Response Team

The National Response Team (NRT) and Regional Response Teams (RRTs) provide an existing structure for the coordination of activities undertaken by the agencies and States that may be involved in a response action. The NRT and RRTs can provide points of contact in Federal agencies or State governments for obtaining information necessary to the feasibility study, and may be able to provide equipment or other support in performance of the remedial action.

4.5.7 Other Government Authorities

Certain other agencies may also give advice useful in planning and implementing remedial actions. These agencies and their potential roles in remedial actions include:

- The Advisory Council on Historic Preservation can consult on remedial actions involving landmarks, historic sites, or areas of scientific, cultural, or historic interest.
- The Bureau of Land Management (BLM) of the Department of the Interior may be helpful when a remedial action involves Federal lands on which BLM has authority over waste disposal or access, such as floodplains and landmarks.
- The Fish and Wildlife Service of the Department of the Interior can provide advice and information on preventing or lessening impacts on fish and wildlife, especially game species; identifying threatened and endangered species; identifying habitats of special interest; and listing or mapping wetlands. This information would be useful in applying for permits for the discharge of dredged or fill material.
- The Forest Service of the Department of Agriculture can provide advice and information on the Wild and Scenic Rivers System.
- The Heritage Conservation and Recreation Service of the Department of the Interior can provide advice and information on National Register of Historic Places and Natural Areas.
- The Department of Housing and Urban Development can provide floodplain maps.
- The Department of Transportation may be helpful if the remedial alternative involves off-site transport of hazardous wastes.

4.6 COMMUNITY RELATIONS

Community relations activities are an integral part of every Superfund-financed remedial action whether it be Federal-, State-, or private party-lead, regardless of the choice of remedial alternatives. The EPA's "Community Relations in Superfund: A Handbook"[4] supplements this section with background material, the community relations requirements and more detailed procedural guidance on planning and implementing effective community relations programs.

A community relations plan (CRP) is a management and planning tool that outlines the specific communications activities to be used during a Superfund response and the integration of these activities with technical work at the site. The plan must be based on interviews conducted within the community with local officials, civic leaders, community residents and leaders, and public interest groups.

To provide a meaningful opportunity for public comment, the following steps must be included in the community relations program:

1. Interviews with interested and affected community residents must be conducted to determine level of interest, major issues, and information needs.

2. Based on the community interviews, a community relations plan is developed for the site before RI field work begins.

3. Regions must provide local notice of the availability of the draft feasibility study. This notice can be provided through publication in local newspapers and through civic groups or other organizations. The draft feasibility study should be placed in local information repositories such as community libraries or churches.

4. At least 3 weeks must be allowed for comment, measured from the date of notice of availability of the draft RI/FS study. The Superfund coordinator, in consultation with the EPA Regional Administrator, can allot additional time. In general, unless the site problem is highly technical and citizen concern is high, 3 weeks should be sufficient, so long as the draft study is expeditiously distributed. An informal meeting or briefing can be held at the beginning of the review period to discuss the results of the draft study.

5. A responsiveness summary must be included in the final feasibility study.

In addition to these steps, the following should be performed so that the community relations program is procedurally equivalent to the public participation requirements of the Federal Environmental Impact Statement Program:

- A fact sheet should be included with the public notice and feasibility study provided to the public 2 weeks before the 3-week public comment period. The fact sheet must clearly summarize the

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[4] Interim version, September 1983.

feasibility study response alternatives and other issues, including which alternatives comply with other environmental laws. For alternatives that meet the goals of CERCLA in protecting human health and the environment but do not meet the technical requirements of other environmental laws, the fact sheet shall identify the ways they differ and the reason for each difference. The public notice should include the schedule on which a decision will be reached, any tentative determinations made by the Agency, the location where relevant documents can be obtained, community involvement opportunities, the name of an Agency contact, and other appropriate information.

- A public notice and updated fact sheet should be prepared when the Agency has selected the response action and again when the final engineering design is complete, to demonstrate that the remedy provides adequate protection and satisfies the public's concerns.
- If a remedy is identified that is different from those proposed during the public comment period on the feasibility study, a new 3-week public comment period may be required before the Record of Decision is amended, taking into consideration the features of the alternatives addressed in the public comment period.

In evaluating remedial alternatives, the user should be sensitive to public perception of the alternatives. Alternatives perceived to be unacceptable by the community may be delayed or prohibited by zoning changes or other measures. Steps necessary to address public concerns and incorporate citizen input when feasible should be taken as early as possible.

4.7 SUMMARY OF INSTITUTIONAL REQUIREMENTS

This section summarizes, in table form, Federal, State, and local requirements applicable or relevant to response actions. Tables 4-1 and 4-2 are intended as a checklist for users; it should not be used as a substitute for the actual regulations and policies.

TABLE 4-1. APPLICABLE OR RELEVANT REQUIREMENTS

1. Office of Solid Waste

- Open Dump Criteria (RCRA Subtitle D, 40 CFR Part 257)

  Note: Only relevant to nonhazardous wastes. In most situations, Superfund wastes will be handled in accordance with RCRA Subtitle C requirements.

- Hazardous Waste Regulations (RCRA Subtitle C, 40 CFR Part 264) including liner, cap, ground-water, and closure requirements under the following subparts:

  F. Ground-Water Protection
  G. Closure and Post-Closure[5]
  H. Financial Requirements
  I. Use and Management of Containers
  J. Tanks
  K. Surface Impoundments
  L. Waste Piles
  M. Land Treatment
  N. Landfills
  O. Incinerators

2. Office of Water

- Maximum Contaminant Levels (for all sources of drinking water exposure)

- Underground Injection Control Regulations

- State Water Quality Standards (applicable for surface water discharge)

- Requirements established pursuant to sections 301 and 403 of the Clean Water Act

- Ocean Dumping Requirements including incineration at sea

- Pretreatment standards for discharge into publicly owned treatment works (POTW).

(continued)

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[5] Applies to enforcement action, not applicable or relevant to Fund-financed actions.

TABLE 4-1. (continued)

3. Office of Pesticides and Toxic Substances

   - PCB Requirements including Disposal and Marking Rule (43 FR 7150, 2/17/78); PCB Ban Rule (44 FR 31514, 5/31/79).
   - 40 CFR 775 Subpart J - Disposal of Waste Material Containing TCDD.

4. Office of External Affairs

   - Guidelines for Specification of Disposal Sites for Dredged or Fill Material [§404(b)(1) Guidelines, 40 CFR Part 230]
   - Denial or Restriction of Disposal Site for Dredged Material: Final Rule [§404(c)].

5. Office of Air and Radiation

   - Uranium mill tailing rules
   - National Ambient Air Quality Standards
   - High- and low-level radioactive waste rule
   - Asbestos disposal rules

6. Other Federal Requirements

   - OSHA requirements
   - Preservation of scientific, historical, or archeological data
   - D.O.T. Hazardous Materials Transport Rules
   - Regulation of activities in or affecting waters of the United States pursuant to 33 CFR Parts 320-329
   - The following requirements are triggered by Fund-financed actions:
     - Preservation of rivers on the national inventory, Wild and Scenic Rivers Act, §7, 40 CFR Part 6.302(e)

(continued)

TABLE 4-1. (continued)

- Protection of threatened or endangered species and their habitats
- Conservation of Wildlife Resources
- Executive Orders related to Floodplains (11988) and Wetlands (11990)
- Coastal Zone Management Act.

TABLE 4-2. OTHER REQUIREMENTS, ADVISORIES, AND GUIDANCE TO BE CONSIDERED

1. Federal Requirements, Advisories, and Procedures

   A. Recommended Maximum Concentration Limits (RMCLs)

   B. Health Advisories, EPA, Office of Water

   C. Federal Water Quality Criteria

      Note: Federal water quality criteria are not legally enforceable. State water quality standards, developed using appropriate aspects of Federal water quality criteria, are legally enforceable. In many cases, States water quality standards do not include specific numerical limitations on a large number of priority pollutants. When there are no numerical State standards for a given pollutant, Federal water quality criteria should be considered.

   D. Pesticide and food additive tolerances and action levels data

      Note: Germane portions of tolerances and action levels may be relevant to certain situations.

   E. Waste load allocation procedures, EPA Office of Water

   F. Federal sole source aquifer requirements

   G. Public health basis in listing decision under section 112 of the Clean Air Act

   H. EPA ground-water protection strategy

   I. New Source Performance Standards for Storage Vessels for Petroleum Liquids

   J. TSCA health data

   K. Pesticide registration data

   L. TSCA chemical advisories (two or three issued to date)

   M. Advisories issued by FWS and NWFS under the Fish and Wildlife Coordination Act

(continued)

TABLE 4-2. (continued)

   - N. National Environmental Policy Act
   - O. Floodplain and Wetlands Executive Orders.

2. State Requirements
   - A. State Requirements on Disposal and Transport of Radioactive wastes
   - B. State Approval of Water Supply System Additions or Developments
   - C. State Ground-Water Withdrawal Approvals
   - D. Requirements of authorized (RCRA Subtitle C) State hazardous waste programs
   - E. State Implementation Plans and delegated programs under the Clean Air Act
   - F. All other State requirements, not delegated through EPA authority.

     Note: Many other State and local requirements could be relevant. The guidance for feasibility studies will include a more comprehensive list.

3. USEPA RCRA Guidance Documents
   - A. EPA RCRA Design Guidelines
     - 1. Surface Impoundments, Liners Systems, Final Cover, and Freeboard Control
     - 2. Waste Pile Design - Liner Systems
     - 3. Land Treatment Units
     - 4. Landfill Design - Liner System and Final Cover.
   - B. Permitting Guidance Manuals
     - 1. Permit Applicant's Guidance Manual for Hazardous Waste Land Treatment, Storage, Disposal Facilities

(continued)

TABLE 4-2. (continued)

2. Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, Disposal Facilities
3. Permit Writer's Guidance Manual for Subpart F
4. Permit Applicant's Guidance Manual for the General Facility Standards
5. Waste Analysis Plan Guidance Manual
6. Permit Writer's Guidance Manual for Hazardous Waste Tanks
7. Model Permit Application for Existing Incinerators
8. Guidance Manual for Evaluating Permit Applications for the Operation of Hazardous Waste Incinerator Units
9. A Guide for Preparing RCRA Permit Applications for Existing Storage Facilities
10. Guidance Manual on Closure and Post-Closure Interim Status Standards.

C. Technical Resource Documents (TRDs)

1. Evaluating Cover Systems for Solid and Hazardous Waste
2. Hydrologic Simulation of Solid Waste Disposal Sites
3. Landfill and Surface Impoundment Performance Evaluation
4. Lining of Waste Impoundment and Disposal Facilities
5. Management of Hazardous Waste Leachate
6. Guide to the Disposal of Chemically Stabilized and Solidified Waste
7. Closure of Hazardous Waste Surface Impoundments
8. Hazardous Waste Land Treatment

(continued)

TABLE 4-2. (continued)

9. Soil Properties, Classification, and Hydraulic Conductivity Testing.

D. Test Methods for Evaluating Solid Waste

1. Solid Waste Leaching Procedure Manual

2. Methods for the Prediction of Leachate Plume Migration and Mixing

3. Hydrologic Evaluation of Landfill Performance (HELP) Model Hydrologic Simulation on Solid Waste Disposal Sites

4. Procedures for Modeling Flow Through Clay Liners

5. Test Methods for Evaluating Solid Wastes

6. A Method for Determining the Compatibility of Hazardous Wastes

7. Guidance Manual on Hazardous Waste Compatibility

4. USEPA Office of Water Guidance Documents

A. Pretreatment Guidance Documents

1. 304(g) Guidance Document Revised Pretreatment Guidelines (3 Volumes)

Provides technical data describing priority pollutants and their effects on wastewater treatment processes to be used in developing local limits; describes technologies applicable to categorical industries.

B. Water Quality Guidance Documents

1. Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (1977)

2. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses (1983)

Outlines methods for conducting use attainability analyses under the Clean Water Act.

(continued)

TABLE 4-2. (continued)

3. Water-Related Environmental Fate of 129 Priority Pollutants (1979)

   Describes the transformation and transportation of priority pollutants.

4. Water Quality Standards Handbook (1983)

   Provides an overview of the Criteria Standards Program under the Clean Water Act and outlines methods for conducting criteria standards modification.

5. Technical Support Document for Water Quality-Based Toxics Control.

C. NPDES Guidance Documents

1. NPDES Best Management Practices Guidance Manual (June 1981)

   Provides a protocol for evaluating BMPs for controlling discharges of toxic and hazardous substances to receiving waters.

2. Biomonitoring Guidance, July 1983, subsequent biomonitoring policy statements and case studies on toxicity reduction evaluation (May 1983).

D. Ground-Water/UIC Guidance Document

1. Designation of a USDW

2. Elements of Aquifer Identification

3. Interim guidance for public participation

4. Definition of major facilities

5. Corrective action requirements

6. Requirements applicable to wells injecting into, through, or above an aquifer which has been exempted pursuant to §146.104(b)(4).

7. Guidance for UIC implementation on Indian lands.

(continued)

TABLE 4-2. (continued)

   8. Technical Resource Documents (currently under development by OGWP).

5. USEPA Manuals from the Office of Research and Development

   A. SW-846 - laboratory analytic methods

   B. Laboratory protocols developed pursuant to Clean Water Act §304(h).

CHAPTER 5

EVALUATE PROTECTION OF PUBLIC HEALTH REQUIREMENTS

5.1 OVERVIEW

The remedial action selected for a Superfund hazardous waste site must adequately protect public health, welfare, and the environment. This requires documenting that the action minimizes the long-term effects of any residual contamination, and protects the public both during and after the action. This chapter provides interim guidance[1] for ensuring that remedial actions limit the concentrations of toxic substances in the environment to avoid unacceptable threats to human health.

More comprehensive guidance on assessing public health effects is under development. The schedules of many remedial actions, however, make it necessary to disseminate interim guidance for ongoing feasibility studies. This guidance will aid in data collection and decisionmaking until final guidance is prepared. In accordance with current procedures, the public health evaluation may be done by EPA Regions, the State, a responsible party, or their consultants. When the Regional Administrator finds it appropriate, he or she may request the help of EPA's Office of Research and Development (ORD) (for environmental exposure and risk assessments) or the Agency for Toxic Substances and Disease Registry (ATSDR) (for human health studies, health assessments, and health advisories) in evaluating public health effects at a site. EPA's assessments will be developed in consultation with ASTDR so the assessment results will serve as input to ASTDR's public health evaluations for both Fund-financed as well as enforcement cases. Until the necessary toxicological data and guidance on their application can be generated and provided in a standard format, Headquarters personnel will also help in the evaluation, providing necessary information and reviewing final documentation.

An endangerment assessment must be conducted for all enforcement sites. At a minimum, it should establish the potential health and environmental threats of the site in the absence of response action. The endangerment assessment will have some components of the public health assessment described in this chapter, but may be more or less detailed depending on the amount, type and quality of data available. For example, if the endangerment assessment is prepared before an RI has begun or during the initial stages of an RI, less data will be available than if the endangerment assessment is prepared after an RI is completed. For some enforcement sites, the feasibility study public health assessment may serve as the endangerment assessment. Chapter 10 (forthcoming) describes endangerment assessments in detail.

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[1] This chapter contains interim guidance for public health evaluation. Final guidance for public health evaluation will be provided after completion of risk assessment guidelines for evaluating chemical hazards that do not have appropriate standards or criteria.

These interim guidance procedures were developed to account for the great variety of conditions at different Superfund sites. All remedial sites should undergo a public health evaluation, although the form and extent of the assessment will depend on the situation. The interim public health evaluation has several steps (though not all apply to all remedial sites):

- Baseline site evaluation: Preliminary evaluation and classification that all sites must undergo.

- Exposure assessment: Analysis of the extent and duration of human exposure to site contaminants in the absence of remedial action.

- Standards analysis: Comparison of projected environmental concentrations to appropriate ambient standards or criteria.

- Develop, evaluate, and modify remedial alternatives: Evaluation of short- and long-term effects of remedial alternatives to remove or mitigate exposures of concern identified during the exposure assessment. Specific design goals will be based on applicable or relevant standards, or the absence of appropriate standards, to develop at least one option corresponding to a 10^{-6} risk level and other reasonable alternatives corresponding to a 10^{-4} to 10^{-7} risk level.

5.2 DEVELOP A BASELINE SITE EVALUATION

Baseline site evaluation is the first step in public health evaluation for all sites. First, the available data relevant to public health evaluation should be collected, organized, and reviewed. The information collected should include site background data, disposal history (and records, if available), types of remedial technologies considered, on-site and off-site chemical data, site environmental data (e.g., topography and hydrogeology), information on local human populations, and information on human health effects (which may be unavailable). Data sources include preliminary assessment data and reports, field reports, remedial investigation scoping documentation, and analytical data and reports available from ongoing site characterization and alternatives screening activities.

Of particular importance in this initial review is the information used to define the type of action likely to be taken at a site and the level of detail required for the exposure assessment. Sites involving contamination that has not migrated much beyond the source generally call for relatively simple source control measures. Sites that have evidence of contaminant migration beyond the source (e.g., into ground water) may consider source control options as well as management of migration alternatives. Other sites may have such extensive migration of contaminants that only management of migration options would be suitable. These classifications are generally made at the RI/FS scoping stage. The distinctions are important in determining the extent of analysis and evaluation required for each alternative (see section 5.4). Thus, all data on the extent of contamination, contaminant mobility and migration, and types of remedial alternatives should be carefully reviewed. The result of the baseline evaluation should be a determination of the data required to conduct the exposure assessment and the level of detail in this assessment. This evaluation will generally be conducted in conjunction with development of the site sampling plan.

To be considered a source control situation, the site and the remedial alternatives must meet all of the following conditions:

- The known and suspected chemical contamination at the site is restricted to near its original location.
- The remedial alternatives considered include both on-site control measures, and removal and off-site disposal or treatment at a facility approved under the Resource Conservation and Recovery Act (RCRA) or other environmental laws including TSCA, CWA, CAA, MPRSA, or SDWA, as appropriate.
- The remedial alternatives will prevent or minimize releases of contaminants.

Management of migration measures should be evaluated if these conditions are not met.

5.3 DEVELOP AN EXPOSURE ASSESSMENT

At sites where only source control remedial measures are being evaluated, a qualitative assessment of the potential public health threats in the absence of remedial action will generally be conducted. An in-depth quantitative analysis is not warranted in such situations where (1) contamination has not migrated into any transport media capable of producing human exposures and (2) the only actions under consideration are those that prevent such migration. However, at a minimum, a qualitative exposure analysis is required to evaluate the types, amounts, and concentrations of chemicals at the site, their toxic effects, the proximity of target populations, the likelihood of chemical release and migration from the site, and the potential for exposure. This health assessment requires written documentation.

Source control alternatives will be based on acceptable engineering practice for preventing off-site releases and on applicable or relevant standards (e.g., RCRA design standards). Quantitative health risk assessment will usually not be required for alternative selection or design at these sites. However, the reliability of such remedies should be evaluated in the context of engineering practicality as set forth in chapter 3. In those situations, the operation and maintenance agreement should include effective monitoring provisions to ensure that a failure would be identified prior to human or environmental exposure.

At sites where management of migration options are being considered, a quantitative exposure assessment should be undertaken. The objective of exposure assessment is to estimate the frequency, magnitude, and duration of human exposure to toxic chemical contaminants released from a site. Several tasks are required in this assessment:

- Identifying chemicals present at the site and selecting indicator chemicals (based on toxicity, persistence, mobility, and quantity present)
- Identifying points of potential human exposure and exposure pathways for each remedial alternative considered
- Characterizing populations potentially at risk
- Estimating at key exposure points the environmental concentrations of each indicator substance.

In some situations, there may only be a small number of chemicals present and all chemicals may be evaluated. At sites where there are a large number of chemicals, specific indicator chemicals may be selected to facilitate a manageable analytical and design effort. These indicators should represent the most toxic, persistent, mobile, and prevalent chemicals at the site. While this document promotes the use of indicator chemicals in the development and analysis of alternatives, EPA recognizes there may be some short comings in developing alternatives that must be in compliance with RCRA regulations (CFR Part 264). In these instances, the project manager should consult with the EPA RCRA office to determine the minimum requirements for analyzing constituents at the site. In many cases, an analysis of RCRA Appendix VIII constituents can be demonstrated using carefully selected indicator chemicals.

Table 5-1 provides a reasonably complete list of questions that should be answered in an exposure assessment. These questions apply to both qualitative and quantitative assessments. Because extreme uncertainties are likely, a critical part of all exposure assessments is documenting assumptions and other sources of uncertainty. A detailed manual for conducting exposure assessments is under development. In the interim, project managers should use their best judgement in characterizing each of the above elements.

TABLE 5-1. QUESTIONS IN EXPOSURE ASSESSMENT

I. Chemical Identification

- A. What chemicals are known or suspected to have been disposed at the site?
- B. What quantities of each chemical were disposed?
- C. How were they disposed (bulk dumping, drums, bulk storage)?
- D. Which chemicals are now in the environment (air, land, surface water, ground water)?
- E. What are the ambient levels of these chemicals in the air, ground water, surface water, and soil?
- F. What conditions or events could affect contamination levels on- and off-site?
- G. What chemicals can be used as indicators of the overall risk at the site?

II. Surrounding Population

- A. Describe the population surrounding the site:
  - 1. How many people are potentially exposed?
  - 2. Who are they (especially high-risk groups, e.g., children, the elderly, or the ill)?
  - 3. Where is the population located relative to the site?
  - 4. Is the area mainly for residence or business?
  - 5. What type of access is there to the site?
  - 6. What normal activities might be affected by contamination (e.g., farming by contaminated soil)?
- B. What, if any, health-related complaints have been received? Have these been documented or proven to be related to the site?

III. Potential Exposure Routes

- A. Unavoidable on-site exposure (residences, etc.)
  - 1. How are people exposed?
  - 2. What are the routes of exposure (through inhalation, the skin, or ingestion)?
  - 3. To what chemicals are people exposed?
  - 4. To what levels are they exposed (use monitoring data and modeling if appropriate)?

(continued)

TABLE 5-1. (continued)

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5. How many people are exposed at these levels (i.e., through each pathway)?

- B. Voluntary on-site exposure
  1. How are people exposed?
  2. What are the routes of exposure (through inhalation, the skin, or ingestion)?
  3. To what chemicals are people exposed?
  4. To what levels are they exposed (use monitoring data and modeling if appropriate) and how many people are exposed at these levels (i.e., through each pathway)?
  5. Can this exposure be prevented?
- C. Off-site exposure (actual and potential)
  1. What environmental routes must chemicals take for exposure?
  2. How likely are these routes of exposure?
  3. When is exposure expected to occur?
  4. How are people exposed (through inhalation, the skin, or ingestion)?
  5. To what chemicals are people exposed?
  6. To what levels are they exposed (use monitoring data and modeling if appropriate)?
  7. How many people are exposed at these levels (i.e., through each pathway)?
- D. Other non-waste-related exposures
  1. Is the population, or are segments of the population, exposed to any of these chemicals from other routes, e.g., in the workplace?
  2. Are the ambient environmental levels of any of the chemicals known?
  3. Are they suspected to be abnormally high for any reason?

IV. The Effect of Not Taking Action

- A. Technical issues
  1. What will happen if no action is taken (e.g., lagoon failure, aquifer contamination, drum failure, air contamination)?
  2. What chemicals will be of concern?

(continued)

TABLE 5-1. (continued)

B. Exposure issues
1. What exposure will result from not taking action?
2. Will exposure increase indefinitely?
3. Will exposure rise and then fall? Over what time?
4. What is the predicted range of eventual contamination and exposure?

5.4 COMPARE ALTERNATIVES TO APPLICABLE OR RELEVANT ENVIRONMENTAL STANDARDS

Following the exposure assessment, estimated environmental concentrations of the indicator chemicals selected for that site should be compared to applicable or relevant environmental standards and criteria.

This comparison must be made for each of the alternatives discussed in section 4.2. Table 5-2 lists substance-specific relevant and applicable numerical standards as well as other numerical criteria, advisories, and guidance to be considered in the analysis of alternatives. (See Appendix C, CERCLA Compliance with the Requirements of Other Environmental Statutes, for a more complete listing of various types of standards, criteria, advisories, and guidance.) There may be some situations where applicable or relevant standards listed in Tables 5-2 and 4-1 are not applicable to specific site situations (for example, see section 5.4.2). There may be situations, as well, where there are relevant or applicable standards that cover only some of the substances at a site. In contrast to these two situations, it is more likely that a project manager will more frequently use relevant or applicable technology-based standards (e.g., 40 CFR 264, treatment, storage, and disposal regulations under the Resource Conservation and Recovery Act) or consider other advisories, criteria, and guidance for specific substances at a site in fashioning alternative remedies.

In fashioning alternatives, it is first necessary to determine whether any relevant or applicable standards exist. Applicable standards are those that would legally apply if the action was not being taken under CERCLA. Relevant standards are those designed to apply to circumstances sufficiently similar to those encountered at CERCLA sites in which their application would be appropriate at a specific site although not legally required. These relevant and applicable standards (both technology- and substance-specific) should be used as primary design goals. In addition, other advisories, criteria, and guidance should be considered, especially in cases where relevant and applicable standards do not exist. Other advisories, criteria, and guidance should be examined closely to determine whether they need to be modified to fit site conditions (e.g., where exposure assumptions underlying a criterion are significantly different than site conditions). The project manager and decisionmaker will find that the use of other criteria, advisories, and guidance yield somewhat more flexibility in alternatives design and selection than relevant or applicable standards (which must be attained unless one of the five specific circumstances exists). Section 5.4.1 provides a summary of the assumptions underlying some of the standards, criteria, and advisories that may be most frequently used.

As discussed in Chapter 4, five categories of alternatives must be examined:

1. Treatment or disposal at an off-site facility;

2. Those that attain applicable or relevant standards;

TABLE 5-2. EPA AMBIENT STANDARDS AND CRITERIA FOR SUPERFUND REMEDIAL SITES

Chemical	Applicable or Relevant Requirements: Safe Drinking Water Act, MCLs (mg/L unless otherwise noted)	Applicable or Relevant Requirements: Clean Air Act, NAAQS (ug/m^3)	Other Criteria, Advisories, and Guidance: Clean Water Act, Water Quality Criteria for Human Health--Fish and Drinking Water	Other Criteria, Advisories, and Guidance: Clean Water Act, Water Quality Criteria for Human Health--Adjusted for Drinking Water Only[a]	Safe Drinking Water Act, Health Advisories (mg/L): 1-day	Safe Drinking Water Act, Health Advisories (mg/L): 10-day	Safe Drinking Water Act, Health Advisories (mg/L): Chronic (longer term)
Acenaphthene			20 ug/L (organoleptic)[b]	20 ug/L (organoleptic)			
Acrolein			320 ug/L	540 ug/L			
Acrylonitrile			0 (58 ng/L)[c]	0 (63 ng/L)			
Aldrin			0 (0.074 ng/L)	0 (1.2 ng/L)			
Antimony			146 ug/L	146 ug/L			
Arsenic	0.05		0 (2.2 ng/L)	0 (2.5 ng/L)			
Asbestos			0 (30,000 fibers/L)	0 (30,000 fibers/L)			
Barium	1.0						
Benzene			0 (0.66 ug/L)	0 (0.67 ug/L)		0.23	0.07
Benzidine			0 (0.12 ng/L)	0 (0.15 ng/L)			
Beryllium			0 (3.7 ng/L)	0 (3.9 ng/L)			
Cadmium	0.01		10 ug/L	10 ug/L			
Carbon monoxide		40,000 (1-hour)[d] 10,000 (8-hour)[d]					
Carbon tetrachloride			0 (0.4 ug/L)	0 (0.42 ug/L)	0.2	0.02	
Chlordane			0 (0.46 ng/L)	0 (22 ng/L)	0.0625	0.0625	0.0075
Chlorinated benzenes							
Hexachlorobenzene			0 (0.72 ng/L)	0 (21 ng/L)			
1,2,4,5-Tetrachlorobenzene			38 ug/L	180 ug/L			
Pentachlorobenzene			74 ug/L	570 ug/L			
Trichlorobenzene			Insufficient data	Insufficient data			
Monochlorobenzene			488 ug/L	488 ug/L			
Chlorinated ethanes							
1,2-Dichloroethane			0 (0.94 ug/L)	0 (0.94 ug/L)	Insufficient data		
1,1,1-Trichloroethane			18.4 mg/L	19 mg/L			1.0
1,1,2-Trichloroethane			0 (0.6 ug/L)	0 (0.6 ug/L)			
1,1,2,2-Tetrachloroethane			0 (0.17 ug/L)	0 (0.17 ug/L)			
Hexachloroethane			0 (1.9 ug/L)	0 (2.4 ug/L)			
Monochloroethane			Insufficient data	Insufficient data			
1,1-Dichloroethane			Insufficient data	Insufficient data			
1,1,1,2-Tetrachloroethane			Insufficient data	Insufficient data			
Pentachloroethane			Insufficient data	Insufficient data			

(continued)

TABLE 5-2. (continued)

Chemical	Applicable or Relevant Requirements: Safe Drinking Water Act, MCLs (mg/L unless otherwise noted)	Applicable or Relevant Requirements: Clean Air Act, NAAQS (ug/m^3)	Other Criteria, Advisories, and Guidance: Clean Water Act, Water Quality Criteria for Human Health-- Fish and Drinking Water	Other Criteria, Advisories, and Guidance: Clean Water Act, Water Quality Criteria for Human Health-- Adjusted for Drinking Water Only^a	Safe Drinking Water Act, Health Advisories (mg/L): 1-day	Safe Drinking Water Act, Health Advisories (mg/L): 10-day	Safe Drinking Water Act, Health Advisories (mg/L): Chronic (longer term)
Chlorinated naphthalenes			Insufficient data	Insufficient data			
Chlorinated phenols							
3-Monochlorophenol			0.1 ug/L (organoleptic)	0.1 ug/L (organoleptic)			
4-Monochlorophenol			0.1 ug/L (organoleptic)	0.1 ug/L (organoleptic)			
2,3-Dichlorophenol			0.04 ug/L (organoleptic)	0.04 ug/L (organoleptic)			
2,5-Dichlorophenol			0.5 ug/L (organoleptic)	0.5 ug/L (organoleptic)			
2,6-Dichlorophenol			0.2 ug/L (organoleptic)	0.2 ug/L (organoleptic)			
3,4-Dichlorophenol			0.3 ug/L (organoleptic)	0.3 ug/L (organoleptic)			
2,3,4,6-Tetrachlorophenol			1.0 ug/L (organoleptic)	1.0 ug/L (organoleptic)			
2,4,5-Trichlorophenol			2600 ug/L	2600 ug/L			
2,4,6-Trichlorophenol			0 (1.2 ug/L)	0 (1.8 ug/L)			
2-Methyl-4-chlorophenol			1800 ug/L (organoleptic)	1800 ug/L (organoleptic)			
3-Methyl-4-chlorophenol			3000 ug/L (organoleptic)	3000 ug/L (organoleptic)			
3-Methyl-6-chlorophenol			20 ug/L (organoleptic)	20 ug/L (organoleptic)			
Chlorophenoxys							
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.1						
2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP)	0.01						
Chloroalkyl ethers							
bis-(Chloromethyl) ether			0 (0.0038 ng/L)	0 (0.0039 ng/L)			
bis-(2-Chloroethyl) ether			0 (30 ng/L)	0 (30 ng/L)			
bis-(2-Chloroisopropyl) ether			34.7 ug/L	34.7 ug/L			
Chloroform	0.1^e		0 (0.19 ug/L)	0 (0.19 ug/L)			
2-Chlorophenol			0.1 ug/L (organoleptic)	0.1 ug/L (organoleptic)			
Chromium Cr+6	0.05		50 ug/L	50 ug/L			
Cr+3			170 mg/L	179 mg/L			
Copper			1 mg/L (organoleptic)	1 mg/L (organoleptic)			
Cyanide			200 ug/L	200 ug/L			
DDT			0 (0.024 ng/L)	0 (>1.2 ng/L)			
Dichlorobenzenes (all isomers)			400 ug/L	470 ug/L			
Dichlorobenzidines			0 (10.3 ng/L)	0 (20.7 ng/L)			
Dichloroethylenes							
1,1-Dichloroethylene			0 (33 ng/L)	0 (33 ng/L)	1.0		0.07
1,2-Dichloroethylene			Insufficient data	Insufficient data	4.0 2.7	0.4 0.27	(cis isomer) (trans isomer)

(continued)

TABLE 5-2. (continued)

	Applicable or Relevant Requirements		Other Criteria, Advisories, and Guidance				
Chemical	Safe Drinking Water Act, MCLs (mg/L unless otherwise noted)	Clean Air Act, NAAQS (ug/m^3)	Clean Water Act, Water Quality Criteria for Human Health--Fish and Drinking Water	Clean Water Act, Water Quality Criteria for Human Health--Adjusted for Drinking Water Only[a]	Safe Drinking Water Act, Health Advisories (mg/L) 1-day	10-day	Chronic (longer term)
Dichloromethane			See Halomethanes	See Halomethanes	13	1.3	0.15
2,4-Dichlorophenol			3.09 mg/L	3.09 mg/L			
Dichloropropanes/ Dichloropropenes							
Dichloropropanes			Insufficient data	Insufficient data			
Dichloropropenes			87 ug/L	87 ug/L			
Dieldrin			0 (0.071 ng/L)	0 (1.1 ng/L)			
2,4-Dimethylphenol			400 ug/L (organoleptic)	400 ug/L (organoleptic)			
2-4-Dinitrotoluene			0 (0.11 ug/L)	0 (0.11 ug/L)			
p-Dioxane					5.68	0.568	
1,2-Diphenylhydrazine			0 (42 ng/L)	0 (46 ng/L)			
Endosulfan			74 ug/L	138 ug/L			
Endrin	0.0002		1 ug/L	1 ug/L			
Ethylbenzene			1.4 mg/L	2.4 mg/L			
Ethylene glycol					19.0		5.5
Formaldehyde						0.03	
Fluoranthene			42 ug/L	188 ug/L			
Fluoride	1.4-2.4						
Haloethers			Insufficient data	Insufficient data			
Halomethanes			0 (0.19 ug/L)	0 (0.19 ug/L)			
Heptachlor			0 (0.28 ng/L)	0 (11 ng/L)			
Hexachlorobutadiene			0 (0.45 ug/L)	0 (0.45 ug/L)			
Hexachlorocyclohexanes							
Lindane (99% gamma-HCH)	0.004						
alpha-HCH			0 (9.2 ng/L)	0 (13 ng/L)			
beta-HCH			0 (16.3 ng/L)	0 (23.2 ng/L)			
gamma-HCH			0 (18.6 ng/L)	0 (26.4 ng/L)			
delta-HCH			Insufficient data	Insufficient data			
epsilon-HCH			Insufficient data	Insufficient data			
Technical-HCH			0 (12.3 ng/L)	0 (17.4 ng/L)			
Hexachlorocyclopentadiene			206 ug/L	206 ug/L			
n-Hexane					13	4.0	
Hydrocarbons (non-methane)		160 (3-hour)$^{d/f}$					
Isophorone			5.2 mg/L	5.2 mg/L			
Kerosene/fuel oil no. 2						0.35[g] 0.23	

(continued)

TABLE 5-2. (continued)

Chemical	Applicable or Relevant Requirements		Other Criteria, Advisories, and Guidance				
	Safe Drinking Water Act, MCLs (mg/L unless otherwise noted)	Clean Air Act, NAAQS (ug/m^3)	Clean Water Act, Water Quality Criteria for Human Health--Fish and Drinking Water	Clean Water Act, Water Quality Criteria for Human Health--Adjusted for Drinking Water Only[a]	Safe Drinking Water Act, Health Advisories (mg/L) 1-day	10-day	Chronic (longer term)
Lead	0.05	1.5 (90-day)	50 ug/L	50 ug/L			
Mercury	0.002		144 ng/L	10 ug/L			
Methoxychlor	0.1						
Methyl Ethyl Ketone						7.5	0.750
Naphthalene			Insufficient data	Insufficient data			
Nickel			13.4 ug/L	15.4 ug/L			
Nitrate (as N)	10.0						
Nitrobenzene			19.8 mg/L	19.8 mg/L			
Nitrogen dioxide		100 (1-year)[h]					
Nitrophenols							
2,4-Dinitro-o-cresol			13.4 ug/L	13.6 ug/L			
Dinitrophenol			70 ug/L	70 ug/L			
Mononitrophenol			Insufficient data	Insufficient data			
Trinitrophenol			Insufficient data	Insufficient data			
Nitrosamines							
n-Nitrosodimethylamine			0 (1.4 ng/L)	0 (1.4 ng/L)			
n-Nitrosodiethylamine			0 (0.8 ng/L)	0 (0.8 ng/L)			
n-Nitrosodi-n-butylamine			0 (6.4 ng/L)	0 (6.4 ng/L)			
n-Nitrosodiphenylamine			0 (4.9 ug/L)	0 (7.0 ug/L)			
n-Nitrosopyrrolidine			0 (16 ng/L)	0 (16 ng/L)			
Ozone		235 (1-hour)					
Particulate Matter		260 (24-hour)[d] 75 (24-hour)[i]					
Pentachlorophenol			1.01 mg/L	1.01 mg/L			
Phenol			3.5 mg/L	3.5 mg/L			
Phthalate esters							
Dimethylphthalate			313 mg/L	350 mg/L			
Diethylphthalate			350 mg/L	434 mg/L			
Dibutylphthalate			34 mg/L	44 mg/L			
Di-2-ethylhexyl-phthalate			15 mg/L	21 mg/L			
Polychlorinated biphenyls (PCBs)			0 (0.079 ng/L)	0 (>12.6 ng/L)	0.125	0.0125	
Polynuclear aromatic hydrocarbons (PAHs)			0 (2.8 ng/L)	0 (3.1 ng/L)			

(continued)

TABLE 5-2. (continued)

Chemical	Applicable or Relevant Requirements: Safe Drinking Water Act, MCLs (mg/L unless otherwise noted)	Applicable or Relevant Requirements: Clean Air Act, NAAQS (ug/m^3)	Other Criteria, Advisories, and Guidance: Clean Water Act, Water Quality Criteria for Human Health--Fish and Drinking Water	Other Criteria, Advisories, and Guidance: Clean Water Act, Water Quality Criteria for Human Health--Adjusted for Drinking Water Only[a]	Safe Drinking Water Act, Health Advisories (mg/L): 1-day	Safe Drinking Water Act, Health Advisories (mg/L): 10-day	Safe Drinking Water Act, Health Advisories (mg/L): Chronic (longer term)
Radionuclides							
Radium-226 and 228	5 pCi/L						
Gross alpha activity	15 pCi/L						
Tritium	20,000 pCi/L						
Strontium-90	8 pCi/L						
Other man-made	j						
Selenium	0.01		10 ug/L	10 ug/L			
Silver	0.05		50 ug/L	50 ug/L			
Sulfur dioxide		365 (24-hour)[d] 80 (1-year)[h]					
2,3,7,8-TCDD			0 (0.000013 ng/L)	0 (0.00018 ng/L)			
Tetrachloroethylene			0 (0.8 ug/L)	0 (0.88 ug/L)	2.3	0.175	0.02
Thallium			13 ug/L	17.8 ug/L			
Toluene			14.3 mg/L	15 mg/L	21.5	2.2	0.34
Toxaphene	0.005		0 (0.71 mg/L)	0 (25.8 mg/L)			
Trichloroethylene			0 (2.7 ug/L)	(2.8 ug/L)	2.0	0.2	0.075
Trihalomethanes (total)[k]	0.1						
Vinyl chloride			0 (2.0 ug/L)	(2.0 ug/L)			
Xylenes					12	1.2	0.62
Zinc			5 mg/L (organoleptic)	5 mg/L (organoleptic)			

[a] These adjusted criteria, for drinking water ingestion only, were derived from published EPA Water Quality Criteria (45 FR 79318-79379, November 28, 1980) for combined fish and drinking water ingestion and for fish ingestion alone. These adjusted values are not official EPA Water Quality Criteria, but may be appropriate for Superfund sites with contaminated ground water. In the derivation of these values, intake was assumed to be 2 liters/day for drinking water and 6.5 grams/day for fish; human body weight was assumed to be 70 kilograms.

[b] Criteria designated as organoleptic are based on taste and odor effects, not human health effects. Health-based Water Quality Criteria are not available for these chemicals.

[c] The criterion for all carcinogens is zero; the concentration given in parentheses corresponds to a carcinogenic risk of 10^{-6}. Water Quality Criteria documents present concentrations resulting in risks from 10^{-5} to 10^{-7}. To obtain concentrations corresponding to risks of 10^{-4} and 10^{-5}, the 10^{-6} concentrations should be multiplied by 100 and 10, respectively. To obtain concentrations corresponding to risk of 10^{-7}, 10^{-6} concentrations should be divided by 10.

(continued)

TABLE 5-2. (continued)

[d] Annual maximum concentration not to be exceeded more than once per year.

[e] Chloroform is one of four trihalomethanes whose sum concentration must be less than 0.1 mg/L.

[f] As a guide in devising implementation plans for achieving oxidant standards.

[g] Seven-day health advisory for benzene and benzo(a)pyrene in kerosene, respectively.

[h] Annual arithmetic mean concentration.

[i] Annual geometric mean concentration.

[j] Activity corresponding to total body or any internal organ dose of 4 mrem/year.

[k] Total trihalomethanes refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

3. Those that exceed applicable or relevant standards, as appropriate;

4. Those that do not attain applicable or relevant standards but will reduce the likelihood of present or future threats to public health; and

5. A no action alternative.

In completing the public health evaluation, the extent to which each alternative attains or exceeds relevant or applicable standards, criteria, advisories, or guidance should be carefully documented. If no relevant or applicable standards exist, all of the alternatives will fall in categories 1, 3, and 5 above. Chapter 4 also discusses five specific circumstances that may exist which would justify selection of an alternative in the fourth category above, even if relevant or applicable standards do exist. The analysis of an alternative in the last category must be carefully documented.

5.4.1 Assumptions Underlying Applicable and Relevant Standards

Since the applicable and relevant standards in Table 4-1 and 5-2 were developed under a variety of statutes, many incorporate economic or scientific factors that do not match specific conditions at a CERCLA site. For example, the standards generally do not consider simultaneous exposures from multiple routes. Standards may also be based on different levels, durations, or frequencies of exposure than are likely at a specific site. The assumptions underlying the Tables 4-1 and 5-2 standards that are most frequently relevant and applicable at Superfund sites are discussed briefly in the following sections.

5.4.2 Resource Conservation and Recovery Act Hazardous Waste Regulations (40 CFR 264)

Portions of these regulations include technology based requirements for ground-water protection, closure and post-closure actions, surface impoundments, waste piles, land treatment, landfills, and incinerators. In some cases, these requirements may not be applicable or relevant to specific site conditions such as in the cases where 200 miles of roadway shoulder was contaminated with PCBs, or where acres of forest were sprayed with waste substances. In other cases, these regulations require meeting public health-based standards (either background, SDWA Maximum Contaminant Levels, or Alternate Concentration Limits) as cleanup standards for corrective action. The background and MCL standards may be used directly in developing a remedial alternative. An ACL, however, requires a demonstration that concentrations higher than an MCL will not be adverse to human health or the environment. The EPA Office of Solid Waste is revising its ACL guidance. In the interim, it is advisable to consult with OSW or OERR headquarters staff to determine whether an ACL is an appropriate standard to pursue.

5.4.3 National Interim Primary Drinking Water Standards (NIPDWs) and Maximum Contaminant Levels (MCLs)

Standards under the Safe Drinking Water Act are promulgated as MCLs, which represent the allowable levels in public water systems. As a matter of policy, CERCLA will also use them for other drinking water exposures. They are generally based on lifetime exposure to the contaminant for a 70-kg (154-pound) adult who consumes 2 liters (0.53 gallons) of water per day. The total environmental exposure to contaminants was generally considered in calculating specific MCLs. EPA estimated the amount of the substance to which the average person is likely to be exposed from all sources (air, food, water, etc.), and then determined the fraction of the total intake from drinking water.

In addition to addressing health factors, an MCL is required by law to reflect the technological and economic feasibility of removing the contaminant from the water supply. The limit set must be feasible given the best available technology and treatment techniques. A margin of safety is included in each of the standards. Safety margins vary from chemical to chemical because of the very different risks associated with each. EPA is now developing recommended MCLs (RMCLs) for drinking water based entirely on health considerations.

5.4.4 National Ambient Air Quality Standards (NAAQS)

In developing NAAQS, all sources of exposure to the contaminant (food, water, air, etc.) are considered in determining the health risk. In addition, by statute, NAAQS must be based exclusively on the air quality criteria issued by EPA for each air pollutant. The Clean Air Act does not require EPA to consider the economics of achieving the standards or the technological feasibility of implementing them. Standards can be promulgated as annual maximums, annual geometric means, or annual arithmetic means, or for other time periods from one hour to one year, depending on the pollutant.

Primary standards must allow an adequate safety margin for unidentified hazards and effects, though no rule is used in setting this margin. The law requires EPA to direct its attention to particularly sensitive citizens, such as bronchial asthmatics and emphysematics. In developing primary NAAQS, EPA must specify the nature and severity of the health effects of each contaminant, characterize the pertinent sensitive population, determine probable adverse health effects for this population, and estimate the level below which an adequate safety margin reduces or eliminates risks. Primary NAAQS thus depend mainly on the direct health effects of chemicals to sensitive groups calculated according to scientific data.

5.4.5 Federal Water Quality Criteria and State Water Quality Standards

Federal water quality criteria for protecting human health now cover 62 of 65 classes of toxic pollutants. The health assessment criterion is an estimate of the ambient surface water concentration that will not result in adverse health effects in humans, or, in the case of suspect or proven carcinogens, the concentrations associated with incremental cancer risks. The Federal criteria are nonenforceable guidelines and, therefore, are listed as other criteria to be considered in Table 4-2. However, many States have used these criteria in developing enforceable ambient water quality standards. These State standards[2] are considered applicable and relevant to Superfund remedial actions for surface water situations that involve either drinking water or fish ingestion exposure routes.

Water quality standards establish goals for specific water bodies and also serve as the regulatory basis for water quality-based controls beyond the technology-based levels of treatment required by sections 301(b) and 306 of the Clean Water Act. Water quality standards are adopted by States (or, where necessary, promulgated by EPA) to protect the public health or welfare and enhance water quality. A water quality standard consists of two main parts: (1) specification of designated use (or uses) that considers the water body's value for public water supplies; propagation of fish, shellfish, and wildlife; recreational use; navigation; and agricultural, industrial, and other purposes; and (2) criteria specifying numerical limits or other factors necessary to protect the designated use.

States must adopt water quality standards stringent enough to protect designated uses. Numerical criteria may be based on EPA recommendations or on other scientifically defensible methods. States may also modify EPA's recommended criteria to reflect local environmental conditions and human exposure patterns. When a criterion to protect human health must be developed for a chemical that has no national criterion, the user should consult EPA Headquarters for assistance. The latest guidelines for deriving health-related water quality criteria are published in 45 FR 79341 (November 28, 1980). Guidance (unpublished) on modifying human health criteria may be found in the JRB Associates (1982) report "Suggested Protocol by Which States Could Recommend Surface Water Quality Criteria for Specific Water Bodies for the Purpose of Protecting Human Health" (EPA, Office of Water Regulation and Standards). In general, the user will be directed toward specific risk level ranges as described in section 5.7.

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[2] States with specific numerical ambient standards for toxics include Arizona, Arkansas, California, Colorado, District of Columbia, Delaware, Florida, Idaho, Kentucky, Louisiana, Maine, Maryland, Mississippi, Nevada, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Puerto Rico, South Dakota, Virginia, and West Virginia. Appropriate agencies in other states should be consulted to determine if standards have recently been adopted.

For most chemicals, Federal water quality criteria to protect human health are available for two different exposure pathways. One criterion is based on ingestion of both drinking water and aquatic organisms, and the other is based on ingestion of aquatic organisms alone. The criteria calculations incorporate the assumption that a 70-kilogram adult consumes 2 liters of water and/or 6.5 grams of aquatic organisms daily for a 70-year lifetime. Of course, calculations can be made to derive an adjusted criterion for drinking water ingestion only, based on the two published criteria and the same dose assumptions. Table 5-2 lists these adjusted criteria by chemical, along with the published criteria for combined drinking water and aquatic organism ingestion. The adjusted criteria are more appropriate for Superfund sites with groundwater contamination because the criteria are based on a more realistic exposure assumption.

5.4.6 PCBs

Superfund remedial actions should consider EPA's current draft PCB cleanup policy currently under development by the Office of Pesticides and Toxic Substances under authority of the Toxic Substances Control Act (TSCA). Headquarters should be consulted to determine the impact of this policy on specific RI/FS projects. All disposal of PCBs must be in accordance with the PCB disposal and labeling regulations (40 CFR 761).

5.5 CONSIDER OTHER CRITERIA AND ADVISORIES

Tables 4-2 and 5-2 list other criteria, advisories and guidance that should be considered in the development and evaluation of alternatives.

5.5.1 Criteria for Noncarcinogens

On the basis of a survey of the toxicological literature, EPA has developed a "no observed adverse effect level" (NOAEL) for many chemicals. The NOAELs are usually based on animal studies, although human data are used wherever available. Safety factors are then applied to account for the uncertainty in using available data to calculate human effects resulting in an acceptable daily intake (ADI). Criteria (e.g., water concentrations) are derived from the ADIs and the standard dose assumptions given above.

5.5.2 Criteria for Carcinogens

The same exposure pathways and dose assumptions are used for carcinogens as for noncarcinogens. A literature search of human and animal carcinogenic effects forms the basis for EPA's estimate of the risk posed by potential human carcinogens. There is no scientific basis for estimating "safe" levels of carcinogens because there is no way at present to establish a threshold for carcinogenic effects. Criteria for all carcinogens state that the recommended concentration for maximum protection of human health is zero. EPA has also estimated water concentrations corresponding to incremental risk levels using a linear, nonthreshold extrapolation model. Extrapolation models provide only an estimate of risk, but are the best available tool for describing the potential threat of a substance, given certain assumptions. In its criteria, EPA provides water concentrations corresponding to incremental lifetime cancer risks of 10^{-7}, 10^{-6}, and 10^{-5}.

5.5.3 Health Advisories (SNARLs)

In addition to MCLs, EPA also provides drinking water suppliers with guidance on chemicals that may be intermittently encountered in water systems and are believed to pose a near-term risk, yet are unregulated in drinking water. These guidelines are developed by the Office of Drinking Water in the form of health advisories or SNARLs. Health advisories are not mandatory. They are calculated to reflect the consumption and toxicological characteristics of a 10-kg child (1-year-old infant) who consumes an estimated 1 liter of water daily. SNARLs are calculated for three exposure levels: 1 day, 7 or 10 days, and for a longer term (weeks or months). A safety margin is factored in to protect the most sensitive members of the general population. However, SNARLs ignore carcinogenic risks and synergistic effects of chemicals. SNARLs for certain chemicals contain carcinogenic risk estimates that can be used when appropriate.

5.6 ADJUSTMENT OF STANDARDS AND CRITERIA

As a result of various technical aspects of standards development, some concentration limits will require adjustment before being applied to a specific site. The first step is to determine whether each concentration limit is directly applicable or must be adjusted for the specific site conditions. As an illustration of this, water quality criteria, which were developed for surface water, can be adjusted for ground water by recalculating and excluding the assumption of fish ingestion (as in Table 5-2). Additional guidance on adjusting standards for specific sites is under development.

5.7 UNAVAILABLE OR INAPPROPRIATE STANDARDS

As Table 5-2 shows, relevant or applicable ambient concentration limits are not available for all media for many chemicals commonly found at Superfund sites.

Where no relevant or applicable standards are available, the user should consult headquarters on a case-by-case basis for further guidance. In general, headquarters will instruct the user to develop at least one option that corresponds to a 10^{-6} risk level. In addition, the user will be instructed to develop reasonable alternatives that correspond to a 10^{-4} to 10^{-7} risk level. The specific manner of presentation of exposure and risk levels will be in accordance with Agency guidelines (USEPA, 1984a-f). Further, it may be necessary for headquarters to request review by other program offices to determine the appropriate response.

Guidance on risk assessment is under development for those situations where relevant or applicable standards are not available for every chemical of concern. The guidance will specify procedures for both carcinogens and non-carcinogens, and will address the issue of chemical mixtures. Furthermore, the guidance will specify the risk range that alternatives will be designed to meet.

5.8 SUMMARY OF PUBLIC HEALTH EVALUATION

A summary of the public health effectiveness must be presented for each alternative analyzed. This includes an evaluation of the extent to which each alternative attains, exceeds, or falls short of applicable or relevant environmental standards. Where these are not available, the analysis for management of migration alternatives should evaluate the risks of various exposure levels projected or remaining after implementation of the alternative under consideration. Table 5-3 presents key questions to be summarized in quantifying the public health effects associated with each alternative. The summary presentation is also addressed in chapter 8.

TABLE 5-3. SUMMARY OF KEY PUBLIC HEALTH EVALUATION QUESTIONS

A. Technical issues

1. What technologies will minimize or prevent exposures otherwise expected at the site?
2. What chemical releases will be minimized or prevented by the remedial action?
3. What chemical releases will not be minimized or prevented?
4. Over what time will chemical concentrations be reduced at receptor locations, e.g., on-site, at drinking water intakes, in ambient air, etc.? (Be as specific as possible, providing qualifications if necessary.)

B. Exposure issues

1. What exposure is expected during the remedial action?
2. What exposure is expected after the remedial action?
3. What relevant and applicable standards will be met/not met?
4. What other criteria, guidance or advisories will be met?
5. What adjustments were made to standards, criteria, advisories, or guidance?

CHAPTER 6

EVALUATE ENVIRONMENTAL IMPACTS

In developing and evaluating response alternatives, a major concern is adequate remediation and protection of the environment. The National Oil and Hazardous Substances Contingency Plan (NCP) requires, in section 300.68(i)(2)(D)[1]:

> An assessment of each alternative in terms of the extent to which it is expected to effectively mitigate and minimize damage to, and provide adequate protection of, public health, welfare, and the environment, relative to the other alternatives analyzed....

Section 300.68(i)(2)(E) requires:

> An analysis of any adverse environmental impacts, methods for mitigating these impacts, and costs of mitigation.

This chapter provides guidance for preparing the environmental assessment of proposed remedial alternatives. Generally accepted methods of environmental analysis will be appropriate for many hazardous waste sites, but unique conditions may require innovative procedures. The evaluation of alternatives should be performed by persons with expertise in the environmental sciences and should be based on the best available data and evaluation techniques appropriate for the particular site and the alternatives being addressed.

Environmental contamination is often widespread and may originate from several sources. The environmental assessment should focus on the site problems and pathways of contamination actually addressed by the alternatives identified through screening. The environmental assessment will help determine which remedial alternative(s) will achieve adequate protection and improvement of the environment at those sites where environmental damage is an important consideration. A detailed analysis of environmental effects need not be performed when they are not within the scope of those alternatives. However, any known environmental problems not addressed by the remedial alternatives should be clearly described.

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[1] Federal Register, Vol. 47, No. 137, July 16, 1982.

6.1 OVERVIEW OF THE ENVIRONMENTAL ASSESSMENT

An environmental assessment of the "no-action" alternative should be performed for all sites. This environmental assessment describes the current site situation and the environmental conditions anticipated if no emergency or remedial actions are taken. The assessment should (1) determine the value (or uses) of the areas that are contaminated or threatened with contamination, (2) identify the types of impacts that are likely, and (3) assess the general significance of the impacts.

The user can forego detailed analysis of the adverse effects of any remedial alternatives under consideration if the preliminary analysis conducted during the screening stage shows that implementation will not result in any of the following:

- A substantial increase in airborne emissions
- A new discharge to surface or ground waters
- An increase in the volume of loading of a pollutant from existing sources or a new facility to receiving waters
- Known or expected significant adverse effects on the environment or on human use of environmental resources
- Known or expected direct or indirect adverse effects on environmentally sensitive resources or areas, such as wetlands, prime and unique agricultural lands, aquifer recharge zones, archeological and historical sites, and endangered and threatened species.

The above criteria are based on the concepts of categorical exclusion as provided for in the National Environmental Policy Act and subsequent regulations (40 CFR 1508.4; 40 CFR 6.107, 6.506) and the provisions for a finding of no significant impact (40 CFR 1508.13), which exempts Federal agencies from preparing an Environmental Impact Statement. If an alternative will not result in significant adverse impacts and, therefore, does not require preparation of a detailed environmental assessment of adverse effects, a statement should be prepared that documents that finding and summarizes the supporting reasoning.

6.2 EVALUATE ALTERNATIVE RESPONSES

The environmental assessment should address the effects of each remedial alternative under consideration, including long-term and short-term effects. The level of detail in the environmental assessment should depend on the degree of actual or potential damage to the environment providing the impetus for response. The appropriate level of detail will be determined by the user but should be adequate to compare the expected environmental benefits of different alternatives meaningfully and to determine the extent of the impacts of remedial construction and operations. Such information should assure the public and EPA that the impacts of remedial measures are not significant or result from the only viable option, and should identify problem areas and suggest measures for mitigating adverse impacts.

Factors generally considered in determining the detail demanded include the following: (1) effects on environmentally sensitive areas, (2) violation of environmental standards, (3) short- and long-term effects, and (4) irreversible commitments of resources.

Findings should be presented to allow comparing the environmental effects of alternatives. Environmental effects of remedial actions may include a wide range of effects, including hydrology, geology, air quality, biology, socioeconomics, land use, and archeological and historical sites. In general, each alternative should be evaluated by considering such beneficial effects of the response as changes in the release of contaminants and final environmental conditions, improvements in the biological environment, and improvements in the resources that people use. Expected adverse effects of remedial construction or operations should also be considered in addition to the effects of the final remedy. Each of these topics is discussed further below.

The evaluation should discuss both primary and secondary effects of the remedial action. Primary effects of the remedy are direct adverse or beneficial results and are generally associated with the immediate reason for taking action at the site. Direct adverse effects may result from construction activities, from stabilization following completion of the construction, or from long-term remedial activities. Indirect adverse or beneficial results of the alternative, such as effects on the economy of the area or on migration patterns, generally should not be discussed unless special circumstances affect environmental impacts.

6.2.1 Beneficial Effects of the Response

6.2.1.1 Changes in the Release of Contaminants and Final Environmental Conditions

The user should estimate the effects of remedial measures in terms of the concentrations of contaminants in each environmental medium of concern, both during and after these measures, and the time required to reach desired levels. These evaluations should be the same or similar in content and closely coordinated with those for technical performance and implementability, discussed in chapter 3.

Federal legislation and regulations relevant to assessing environmental impacts were discussed in chapter 4, notably the Clean Water Act; Marine Protection, Research, and Sanctuaries Act; the Clean Air Act and the

National Environmental Policy Act. The regulations under these Acts can provide benchmarks to evaluate current or anticipated environmental conditions.

The ambient residual contamination predicted for different remedial alternatives should be compared to existing criteria and standards. However, available environmental criteria and standards may not always be suitable for direct comparison. The user should determine if the site conditions are substantially different from those used to calculate the criteria. If they are, the criteria should be adapted to actual site conditions. The user should consult with Federal and State agency personnel who have expertise in modifying criteria or in determining criteria for substances that had none. The following sections summarize criteria that have been developed or can be obtained by consultation with Federal and State officials.

Surface Water. Water quality standards establish goals for specific water bodies and also serve as the basis for water quality-based controls beyond the technology-based levels of treatment required by sections 301(b) and 306 of the Clean Water Act. Water quality standards are adopted by States (or, where necessary, promulgated by EPA) to protect the public health or welfare and enhance the quality of the water. A water quality standard consists of two main parts: (1) a specification of designated use (or uses) that considers the water body's value for public water supplies; propagation of fish, shellfish, and wildlife; recreational use; navigation; and agricultural, industrial, and other purposes; and (2) criteria specifying numerical limits or other factors necessary to protect the designated use.

States must adopt water quality criteria stringent enough to protect the designated uses. Table 6-1 identifies States with water quality standards by type of standard. Numerical criteria may be based on EPA recommendations or on other scientifically defensible methods. States may also modify EPA's recommended criteria and set site-specific criteria where (1) background water quality parameters, such as pH, hardness, temperature, and color, appear to differ significantly from the laboratory water used in developing EPA's recommended criteria, or (2) the types of local aquatic organisms differ significantly from those actually tested in developing the EPA's recommended criteria or have adapted to higher pollutant levels. Guidance on modifying national criteria on aquatic life is found in the "Water Quality Standards Handbook" (EPA, December 1983) and the "Draft Technical Support Document For Water Quality-Based Toxics Control" (EPA, Office of Water Regulation and Standards, November 28, 1980). When a criterion must be developed for a chemical for which a national criterion has not been established, the user should consult EPA headquarters for assistance. Guidelines for developing water quality criteria for aquatic life are published in 45 FR 79341 (November 28, 1980). Revisions to these guidelines have been proposed; see 49 FR 4553 (February 7, 1984).

The revised water quality standards regulation (see 40 CFR 131; 48 FR 51400, November 8, 1983) emphasizes criteria for toxic pollutants in State

TABLE 6-1. AVAILABILITY OF STATE AMBIENT WATER QUALITY CRITERIA OR STANDARDS FOR TOXIC SUBSTANCES[a]

State	Freshwater Criteria or Standards[b] (Numerical)	Saltwater Criteria or Standards[b] (Numerical)	Comments
Alabama			
Alaska			
Arizona	X		
Arkansas	X		
California	X		Numerical criteria are effluent limits for total chlorinated pesticides, PCBs, and radioactivity
Colorado	X		
Connecticut			
Delaware			
District of Columbia	X		Adopted 304(a) guidance
Florida	X		
Georgia			
Hawaii			
Idaho	X		
Illinois			
Indiana			
Iowa			
Kansas			
Kentucky	X		
Louisiana	X		Currently revising WQS to include numerical criteria for freshwater
Maine	X		
Maryland			
Massachusetts			

(continued)

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[a] Includes both organic and inorganic contaminants.

[b] Narrative "free-form" toxics criteria for freshwater and saltwater are available for all states.

TABLE 6-1. (continued)[a]

State	Freshwater Criteria or Standards[b] (Numerical)	Saltwater Criteria or Standards[b] (Numerical)	Comments
Michigan			
Minnesota			
Mississippi	X		
Missouri			
Montana			
Nebraska			
Nevada	X		
New Hampshire	X		
New Jersey	X	X	
New Mexico	X		Criteria are only for rivers that have drinking water use designations
New York	X		
North Carolina	X	X	
North Dakota	X		
Ohio	X		
Oklahoma	X		
Oregon		X	
Pennsylvania			
Puerto Rico		X	
Rhode Island			
South Carolina			
South Dakota	X		
Tennessee			
Texas	X		
Utah			
Vermont			
Virginia	X		
Washington			
West Virginia	X		
Wisconsin			
Wyoming			

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[a] Includes both organic inorganic contaminants.

[b] Narrative "free-form" toxics criteria for freshwater and saltwater are available for all states.

standards as the basis for permit limitations under the National Pollutant Discharge Elimination System. Most State standards do not include numerical criteria for many toxic chemicals. When standards do not specify criteria for toxic chemicals, guidance documents on criteria or literature reports are used. All States have a general narrative requirement in their water quality standards that their waters must not contain toxic substances in toxic amounts. Most State standards include a narrative criterion for fish and wildlife designated uses that applies after mixing and requires no chronic toxicity to representative test organisms. These State standards typically include application factors for deriving a discharge chronic toxicity value from an acute toxicity value (i.e., 0.05 for nonpersistent wastes and 0.01 for persistent wastes).

Ground Water. The ground-water policy discussed in chapter 4 provides guidance but not specific ground-water criteria. The user should consult guidance documents appropriate to ground-water protection when they become available from OGWP.

Soils. Two general types of threats should be considered when developing criteria for soils: (1) direct contact by intruders onto the site, and (2) contamination of other environmental media by the soils. Unfortunately, there are no currently promulgated environmental criteria or standards for contaminants in soils, except PCB-contaminated soils, which are subject to TSCA limits. However, procedures for closing existing landfills under RCRA may provide relevant approaches. Also, action levels such as the 1 ppb limit for dioxin established by ASTDR for the Minker Stout site in Missouri may provide further guidance.

Air. Hazardous air pollutants at sites create a serious threat to worker health and safety during investigations and remedial action. Serious air pollution may also result from migration of toxic gases to the surrounding environment and nearby populations. In most instances, a serious air pollution problem would have an impact on public health.

Guidance on source emissions can be obtained from section 112 of the Clean Air Act, which defines an ambient hazardous air pollutant as a substance emitted by a stationary source ("any building, structure, facility, or installation which emits or may emit any air pollutant") that, according to EPA, "causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness." EPA is also required by the 1977 Clean Air Act amendments to review the primary and secondary standards for major criteria pollutants. Users should consult these criteria whenever such pollutants are released into the atmosphere from the site.

When commercial crops are threatened by airborne substances some measure of the air quality should be developed to take account of crop damage. The National Crop Loss Assessment Network gathers data on the relationships between yields of major agricultural crops and exposure to substances like sulfur dioxide.

6.2.1.2 Improvement in the Biological Environment

The user should describe the remedial alternatives' likely improvements in the biological environment. An uncontrolled waste site often threatens nearby biological communities, for example, by changing the ecological structure that supports organisms. The ability of alternatives to reduce or eliminate such threats should be clearly stated.

The user should note the benefits of the alternative, especially with regard to:

- Sole source aquifers
- Wetlands
- Floodplains
- Coastal zone
- Critical habitats
- Prime agricultural lands
- Federal parklands
- National forests
- Wildlife sanctuaries and refuges
- Habitat productivity.

Discussion of these areas can be found in regulations protecting them and in research reports. However, in many cases the user is urged to consult with the relevant Federal, State, local fish and wildlife agencies, and universities for more specific information.

Sole Source Aquifers. A sole source aquifer is designated under section 1424(a)(1) of the Safe Drinking Water Act as being the sole or principal drinking water source for an area and, if contaminated, a significant hazard to public health. EPA has now designated 17 sole source aquifers and is considering petitions for other areas.

Wetlands. Wetlands are areas inundated or saturated by surface water or ground water frequently and persistently enough to support vegetation adapted to saturated soil. Wetlands generally include swamps, marshes, bogs, and similar areas, and may be defined by referring to U.S. Fish and Wildlife Circular 39 (1956) and later revisions resulting from the National Wetlands Inventory. A wetlands assessment must be conducted as part of the feasibility study. EPA is preparing a formal policy for conducting wetlands assessments at Superfund sites. Information on environmental stress and remedial actions for wetlands can be obtained from the U.S. Department of the Interior, the U.S. Department of Commerce, the U.S. Army Corps of Engineers, and appropriate State offices.

Floodplains. One-hundred-year floodplains are designated on Flood Hazard Boundary Maps and Flood Insurance Rate Maps prepared by the U.S. Department of Housing and Urban Development. The user should include a flood assessment if the site is on or near a floodplain. EPA is preparing a formal policy for conducting floodplains assessments at Superfund sites. Information on floodplains can be obtained from the Federal Insurance Administration, the Federal Emergency Management Agency, and appropriate State agencies.

Coastal Zones. Coastal zones are areas subject to management plans under the Coastal Zone Management Act. Information on the effects of releases on coastal zones can be obtained from the Department of Commerce and from State agencies with management responsibilities under the Coastal Zone Management Act.

Critical Habitats of Threatened or Endangered Species. The Secretary of the Interior has determined that certain habitats are critical to the continued existence of threatened or endangered species listed under section 4 of the Endangered Species Act of 1973. Information about effects of releases on threatened and endangered species and critical habitats can be obtained from the Department of the Interior, the Department of Commerce, and State fish and wildlife agencies.

Prime and Unique Farmland. The Department of Agriculture's Soil Conservation Service (SCS) must keep an inventory of important farmlands (7 CFR 757.5). Prime farmland has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. It is also available for pasture, range, and forest land. Unique farmland produces specific high-value food and fiber crops. If the user suspects that prime and unique farmlands are threatened by a site's condition, he or she should contact the State SCS office to verify the farmland's status. Any beneficial effects on such areas should be included in the feasibility study.

Federal Parklands. Federal parklands are areas of recognized scenic, recreational, archeological, or historical value. As required by regulation, when the resource affected is designated by the Federal government, the Federal management agency responsible for the area should be consulted. Designated areas included are national parks, national wilderness areas, national recreational areas, national wild and scenic rivers, national historic places, national natural resource areas, and national wildlife refuges.

National Forests. If a site's condition threatens national forest land, the user should consult the U.S. Forest Service at the Department of Agriculture. The Forest Service is required by the Forest and Rangeland Renewable Resources Planning Act of 1974 and the National Forest Management Act of 1976 to prepare Federal and regional management plans. The user should note the effects of remedial activities on these plans.

Wildlife Sanctuaries and Refuges. Various land management systems protect wildlife sanctuaries and refuges. Public lands are managed by the Bureau of Land Management, the U.S. Fish and Wildlife Service, the National Park Service, the Water and Power Resources Service, the U.S. Forest Service, and the National Oceanic and Atmospheric Administration. Public sanctuaries and refuges are identified in the following systems:

- National park system
- National wildlife refuge system
- National wilderness preservation system
- Wild and scenic river system
- National trail system
- Marine and estuarine sanctuaries program.

State, local, and private sanctuaries should also be considered. Fish and wildlife agencies are good sources of information.

Habitat Productivity. The productivity of the habitat of a commercially or recreationally important species can be threatened by the discharge from an uncontrolled site. Such reduction in productivity can take various forms:

- Loss of species
- Changes in their relative abundance
- Changes in their sizes
- Changes in their age structure.

In such cases, the user should note the species and their habitats and discuss the improvement expected from each alternative. The user may wish to consult the EPA STORET water quality file for data on water quality indicator substances. States often have standards for specific habitats and harvesting areas. The user should consult the appropriate public health and fish and wildlife agencies.

6.2.1.3 Improvements in Resources People Use

Often an uncontrolled site damages or threatens to damage resources people use. Many of these resources, such as fishing waters and recreational areas, directly affect the welfare of local communities. Users should note the ability of alternatives to protect present or potential human uses of resources, especially commercial, residential, recreational, esthetic, and cultural uses.

Commercial Uses. Many environmental resources at sites provide important goods and services traded in the marketplace. Commercially harvested fish are one example (public health concerns also arise in this case because fish is a food). Tackle shops, boat rentals, and hotels can all be affected by deterioration in the environment supporting their goods and services. Sometimes commercial crops are threatened by airborne substances from a site, such as sulfur dioxide and ethylene. The user should consult the National Crop Loss Assessment Network to determine the alternatives' likely improvements. Ground water is a natural resource supporting commercial activities, such as irrigation and water use at commercial facilities. When such activities are affected by the loss or reduction of ground water from discharges at the site, the benefits of the alternatives for commercial activities should be noted.

Residential Uses. Unpleasant physical impacts of the site--such as curtailment of water supply, unpleasant odors, loss of property values, disruption in living patterns, outward migration, and loss of employment--are important considerations in determining the desirability of the remedial alternatives. The user should evaluate the effects of site remediation on residential land use.

Recreational Uses. Response alternatives can improve recreational activities by restoring the environmental resource damaged by the discharge. Open beaches, public waterways, and lakes are among the resources for hunting, fishing, birdwatching, swimming, and camping. Standard parameters measuring recreational uses are number of visitors, number of visitor days, crowd densities, number of licenses, and average catch.

Esthetic Uses. Many environmental resources are appreciated for their esthetic value, which can be impaired either by a discharge or by the response to it. Esthetic value is a subjective matter, and the users of this manual should not be encumbered with an in-depth study of site esthetics. The user's own judgment supported by consultation with local community associations should determine the extent of concern.

6.2.2 Adverse Effects of the Response

6.2.2.1 Expected Effects of Remedial Alternatives

The user should identify and evaluate any expected adverse effects of remedial construction and operations. In identifying these effects, the user should especially consider sensitive environmental areas and resources people use. The user should distinguish inevitable effects from possible ones, so that the evaluation of alternatives can estimate the probability of expected adverse effects. Equally important is recognizing that some effects are irreversible. The users should state that effects are reversible or irreversible if they are significant.

6.2.2.2 Mitigative Measures

If any alternative appears to have significant inevitable or irreversible effects, the user should state the mitigative measures to be taken in conjunction with the alternative. The statement should discuss the technology to be employed and its expected mitigating effects (e.g., percentage reduction in adverse effects). It is generally assumed that mitigating measures will not affect the success of remedial alternatives. If success may be compromised by the mitigative measure, the user should note this.

6.3 OTHER ASSESSMENT PROGRAMS

The user can obtain assistance in developing an assessment program by consulting information on other environmental damage assessment procedures. These procedures have been developed by State and Federal agencies charged with protecting environmental resources. Most have been field tested and reflect the need for applicability rather than the higher methodological rigor characteristic of research. An important element in these procedures is selecting assessment methods that can be used given available time and resources. The following references may be particularly useful:

- Department of Ecology, Washington State, "Guideline for Evaluating Freshwater Resources Damages," 1980.
- National Oceanic and Atmospheric Administration, "Marine Resource Damage Contingency Plan," U.S. Government Printing Office, Washington, D.C., 1980.
- U.S. Fish and Wildlife Service, "Habitat as a Basis for Environmental Assessment," Ecological Service Manual 101. U.S. Government Printing Office, Washington, D.C., 1980.
- Department of Fishery, Washington State, "Marine Water Quality Compendium of Washington State," 1979.
- State of Alaska, "Alaska Oil Spill Status Booklet," 1982.
- Battelle Pacific Northwest Laboratory, "Field Guide for Scientific Support Activities Associated with Superfund Responses," Battelle Memorial Institute, 1979.

6.4 SUMMARY OF ENVIRONMENTAL ANALYSIS

The output format suggested here condenses the discussion of alternatives to five composite criteria. The format is illustrated in Table 6-2.

TABLE 6-2. SUGGESTED SUMMARY FORM FOR USE BY THE ENVIRONMENTAL SECTION TO EVALUATE REMEDIAL ALTERNATIVES

	Beneficial Effects			Adverse Effects[a]	
Alternative	Final Environmental Conditions	Improvements in Biological Environment	Improvements in Human Use Resource	Const/Operation	Mitigative Measures
1st					
2nd					
3nd					
4th					

[a] Indicate whether adverse effects are expected to be reversible or irreversible over time.

The relative desirability of each alternative should be described with respect to each of the evaluation criteria. The user may choose to describe the alternatives in order of their relative desirability with respect to each criterion, or to describe them on an absolute basis according to the degree to which they fulfill each criterion. Whichever method is chosen, the user should provide a consistent discussion of each alternative.

CHAPTER 7

CONDUCT A DETAILED COST ANALYSIS

This chapter outlines the recommended approach to developing and analyzing costs for each of the remedial action alternatives remaining after initial screening (see chapter 2). EPA is developing a "Remedial Action Costing Procedures Manual" which presents more detailed costing procedures. The object of the costing exercise is to develop cost estimates for alternatives, as specified in section 300.68(i)(2)(B)[1] of the NCP:

> (i) Detailed Analysis of Alternatives
>
> (1) A more detailed evaluation will be conducted of the limited number of alternatives that remain after the initial screening in paragraph [h]
>
> (2) The detailed analysis of each alternative should include....
>
> (B) Detailed cost estimation, including distribution of costs over time....

In developing detailed cost estimates, the user should perform the following steps:

1. Estimation of costs: Estimate capital and operation and maintenance costs for remedial action alternatives.
2. Present worth analysis: Using estimated costs, calculate annual costs and present worth for each remedial action alternative.
3. Sensitivity analysis: Evaluate the sensitivity of cost estimates to changes in key parameters, such as discount rates.
4. Summarization of alternatives analysis: Summarize data used in the alternatives analysis for use in selecting a remedial action alternative.

Figure 7-1 illustrates these steps, which are discussed in the following sections.

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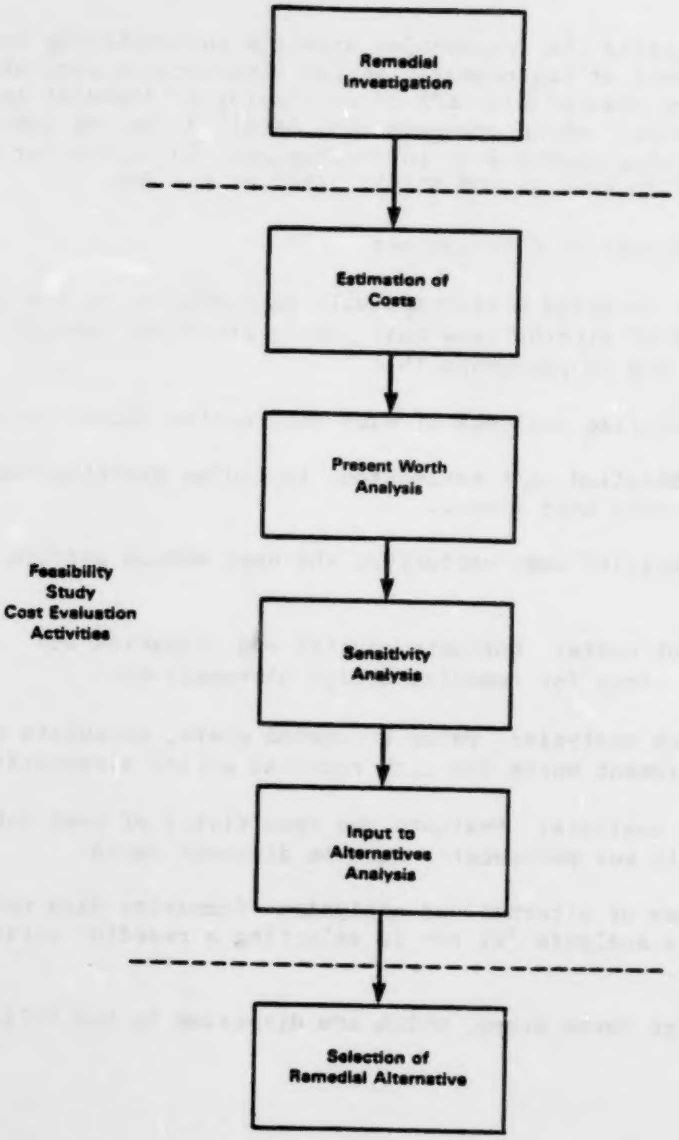
[1] Federal Register, Vol. 47, No. 137, July 16, 1982.

FIGURE 7-1. Feasibility Study Cost Evaluation Process


Remedial Investigation
Estimation of Costs
Present Worth Analysis
Feasibility Study Cost Evaluation Activities
Sensitivity Analysis
Input to Alternatives Analysis
Selection of Remedial Alternative

7.1 ESTIMATION OF COSTS

The user should identify all capital and operation and maintenance costs for each remedial action alternative, and estimate the cost of these components using the sources suggested below under section 7.1.3, "Sources of Cost Information." Where cost estimates are derived from data a year or more old, they should be updated using the cost indices discussed under section 7.1.4, "Updating Costs."

Federal construction programs have traditionally distinguished capital costs from operation and maintenance costs. This distinction is not easily made for Superfund response activities. Often, the completion of construction will not achieve public health or environmental protection, which may be attained only after the remedial technology has operated for a period of time.

However, the distinction must be made to determine which costs are eligible under Superfund. Therefore, Superfund response activities should be divided into two phases for the purposes of determining Fund eligibility: remedial action and post-closure.

Only costs incurred during the remedial action phase are eligible for funding under Superfund. EPA defines remedial actions as activities required to prevent or mitigate migration of hazardous materials released from an uncontrolled site. Remedial actions are directed at achieving cleanup goals. Post-closure activities occur after completion of the remedial action and include continued operations necessary to stop such releases.

The remedial action phase may include activities that have traditionally been considered operation and maintenance costs, as when construction by itself will not achieve cleanup goals. For example, a remedial action addressing ground water contamination may involve pumping, treating, and reinjecting ground water in order to achieve site cleanup. Costs associated with treatment system construction, and continued operation (e.g., labor and utilities) may be eligible. Costs associated with equipment replacement or continued operation following achievement of safe contaminant concentrations would be ineligible for funding. It is important to note that EPA policy regarding Fund eligibility is currently being reviewed. Therefore, a review of the most recent policy may be necessary at the time of feasibility analysis.

In general, the following criteria should be used to distinguish remedial actions from post-closure activities:

- Remedial actions include measures that (1) control contamination at or near the source of the release, (2) result in the initial mitigation of a release to levels protecting public health, welfare, and the environment, (3) have a definable endpoint based on contaminant levels, (4) are related to the initial construction effort (i.e., capping), or are of limited duration (usually less than 4 years).

- Post-closure activities include measures that (1) are required to maintain releases at levels protective of public health, welfare, and the environment, (2) require long-term implementation, (3) have no definable endpoint, (4) maintain the physical integrity of the remedy, or (5) provide for scheduled monitoring or repair.

While the distinction between remedial action and post-closure activities is made for purposes of determining eligibility, it should not be a factor in feasibility cost analysis. Cost estimates should give comparative life-cycle cost information for the remedial action alternatives under consideration. These alternatives should include all costs incurred as part of both the remedial action and post-closure phases. As in conventional construction, cost estimation distinctions are made between capital and operation and maintenance costs.

7.1.1 Capital Costs

Capital costs consist of direct (construction) and indirect (nonconstruction and overhead) costs. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, financial, and other services not part of actual installation activities but required to complete the installation of remedial alternatives. Capital costs that must be increased in future years as part of the remedial action alternative should be identified and noted for the year in which they will occur. It is particularly important to emphasize out year capital costs in the summary of alternatives and to examine the impact of alternative discount rates in the sensitivity analysis. These will be critical factors in making tradeoffs between capital intensive technologies (including alternative treatment and destruction technologies) and non-capital intensive technologies (such as pump and treatment systems).

7.1.1.1 Direct Capital Costs

Direct capital costs may include:

- Construction costs: Costs of materials, labor (including fringe benefits and worker's compensation), and equipment required to install a remedial action.

- Equipment costs: Costs of remedial action and service equipment necessary to enact the remedy; these materials remain until the site remedy is complete.

- Land and site-development costs: Expenses associated with purchase of land and development of existing property.

- Buildings and services costs: Costs of process and nonprocess buildings, utility connections, purchased services, and disposal costs.

- Relocation expenses: Costs of temporary or permanent accommodations for affected nearby residents. (Since cost estimates for relocations can be complicated, FEMA authorities and EPA Headquarters should be consulted in estimating these costs.)

- Disposal costs: Costs of transporting and disposing of waste materials, such as drums and contaminated soils.

7.1.1.2 Indirect Capital Costs

Indirect capital costs may include:

- Engineering expenses: Costs of administration, design, construction supervision, drafting, and testing of remedial action alternatives.

- Legal fees and license or permit costs: Administrative and technical costs necessary to obtain licenses and permits for installation and operation.

- Startup and shakedown costs: Costs incurred during remedial action startup.

- Contingency allowances: Funds to cover costs resulting from unforeseen circumstances, such as adverse weather conditions, strikes, and inadequate site characterization.

7.1.2 Operation and Maintenance Costs

Operation and maintenance costs are post-construction costs necessary to ensure continued effectiveness of a remedial action. The user should consider the following operation and maintenance cost components:

- Operating labor costs: Wages, salaries, training, overhead, and fringe benefits associated with the labor needed for post-construction operations.

- Maintenance materials and labor costs: Costs for labor, parts, and other resources required for routine maintenance of facilities and equipment.

- Auxiliary materials and energy: Costs of such items as chemicals and electricity for treatment plant operations, water and sewer service, and fuel.

- Purchased services: Sampling costs, laboratory fees, and professional fees for which the need can be predicted.

- Administrative costs: Costs associated with administration of remedial action operation and maintenance not included under other categories.

- Insurance, taxes, and licensing costs: Costs of such items as liability and sudden accidental insurance; real estate taxes on purchased land or rights-of-way; licensing fees for certain technologies; and permit renewal and reporting costs.

- Maintenance reserve and contingency funds: Annual payments into escrow funds to cover (1) costs of anticipated replacement or rebuilding of equipment and (2) any large unanticipated operation and maintenance costs.

- Rehabilitation costs: To maintain equipment or structures that wear out over time.

- Other costs: Items that do not fit any of the above categories.

7.1.3 Sources of Cost Information

In estimating costs, the user should consider site-specific factors identified in the remedial investigation and the development of remedial action alternatives. The sources for these estimates are discussed below.

7.1.3.1 Vendor Estimates

Based on detailed site and design information, equipment vendors and construction companies can provide site-specific remedial action construction and equipment cost estimates. Equipment vendors can provide information on their equipment's service requirements. Equipment specifications often provide information on auxiliary materials and energy usage costs. Recommended maintenance schedules can provide a good indication of annual costs, although they are often estimated as percentages of capital costs.

7.1.3.2 Estimates for Similar Projects

Estimates for similar projects or, preferably, actual experience with such projects, are good sources of cost information. Where necessary, these costs should be updated as described below in section 7.1.4.

7.1.3.3 Standard Costing Guidance

Costs may also be estimated using standard costing guides such as the "Means Guide" and the "Dodge Guide" and the various remedial action costing manuals developed by the EPA, including the "Remedial Action Cost Compendium" and the "Handbook: Remedial Action at Waste Disposal Sites" (both published in 1982). If standard construction costing manuals are used, the estimates should be adjusted to allow for the additional costs of safety precautions and reduction of efficiency due to such precautions (i.e., wearing protective equipment).

Labor and energy cost data are published by the Bureau of Labor Statistics (Department of Labor) and Department of Energy, respectively. These sources are particularly useful in determining regional differences in labor, material, and energy costs.

7.1.4 Updating Costs

Cost estimates are frequently based on data several years old and must be updated for the current year. Appropriate cost indices include the following:

- Engineering News Record Construction Cost Index (capital costs of construction)
- Marshall and Stevens Index (for treatment facility costs)
- American City and County Municipal Cost Index (manpower costs)
- The Producer Price Index for Finished Goods, published by the Department of Labor in the Monthly Labor Review.

7.1.5 Accuracy of Cost Estimates

Detailed site characterization information from the remedial investigation should permit the user to refine cost estimates for remedial action alternatives. In some cases, studies will be necessary to determine actual design characteristics so costs can be accurately estimated. Although they may be performed to obtain design data relevant to the feasibility study, such studies should be considered part of the remedial investigation. Only the results of these studies are addressed in the feasibility study. When the applicability of the alternative has been established and can be estimated with the required accuracy, the bench-scale studies could be delayed until after the remedy has been accepted, in which case the engineer should provide a best estimate of design parameters for use in estimating costs.

It is important to consider the accuracy of costs developed for a feasibility study. Typically, these "study estimate" costs provide an accuracy of -30 to +50 percent, and are prepared at relatively low cost using data available from the remedial investigation. Costs developed with accuracies other than -30 to +50 percent should be identified in the feasibility study.

7.2 PRESENT WORTH ANALYSIS

Present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the present. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money, that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life.

In conducting the present worth analysis, assumptions must be made regarding the discount rate and the period of performance. For the first, a discount rate of 10 percent before taxes and after inflation should be assumed, as outlined in OMB Circular No. A-94. This rate represents the average rate of return on private investment. In addition to using a discount rate of 10 percent, it is useful to conduct a sensitivity analysis using other discount rates as well (e.g., 4 percent, 7 percent). This is discussed further in the next section. Estimates of costs in each of the planning years are made in constant dollars, representing the general purchasing power at the time of construction. The period of performance should not exceed 30 years for the purpose of detailed feasibility analysis.

7.3 SENSITIVITY ANALYSIS

After the present worth of each remedial action alternative is calculated, each cost should be evaluated for effects of variations in assumptions through sensitivity analysis. A sensitivity analysis assesses the effect that variations in specific assumptions associated with the design, implementation, operation, discount rate, and effective life of an alternative can have on the estimated cost of the alternative. These assumptions depend on the accuracy of the data developed during the remedial investigation and on predictions of the future behavior of the remedial technology and are subject to varying degrees of uncertainty. The sensitivity of costs to these uncertainties can be observed by varying these assumptions and noting the effects on estimated costs. Sensitivity analysis can also be used to optimize the design of a remedial action alternative, particularly when design parameters are interdependent (e.g., treatment plant capacity for contaminated ground water and the length of the period of performance).

Sensitivity analysis is especially concerned with factors that can significantly change overall costs with only small changes in the values of the factors. Other factors chosen for analysis should be those for which the value is most uncertain. The results of the analysis can be used to identify "worst case" scenarios and to revise estimates of contingency or reserve funds.

The following factors are primary candidates for consideration in conducting sensitivity analysis:

- Effective life of remedial action (replacement)
- Operation and maintenance costs
- Duration of cleanup (period of performance)
- Extent of cleanup, given uncertainty about site conditions
- Other design parameters
- Discount rate.

The choice of a discount rate could be critical in options that include high operation and maintenance costs over extended periods. The user is encouraged to identify those situations when the choice of a 4 percent or 7 percent discount rate would produce a different low cost option. In those situations, sensitivity analyses about differing discount rates should be included in the presentation of alternatives.

The "time value" of money can substantially affect the present worth ranking of competing alternatives, particularly where there is wide disparity between capital and operation and maintenance costs among the alternatives. The sensitivity of the present worth of competing alternatives to the assumed discount rate is best illustrated by an example comparison. Table 7-1 presents an analysis of three ground-water protection/cleanup alternatives at applied discount rates of 4, 7, and 10 percent over 30-year system lives. Application of the lowest discount rate tends to favor (to result in lowest present worth) alternatives having relatively low operation and maintenance costs and high capital costs, while application of the highest discount rate tends to favor alternatives having relatively low capital costs and high operation and maintenance costs. This trend is shown in the ranking of costs of the three alternatives in Table 7-1; it is possible that a given alternative may have the highest, lowest, or an intermediate present worth, depending on the discount rate being considered.

Additional guidance is under development which contains worksheets enabling the user to manipulate key parameters affecting remedial action cost and to measure the resulting effect. The manual also discusses factors the user may choose to analyze, and provides an example showing completed worksheets for a hypothetical alternative.

TABLE 7-1. PRESENT WORTH ANALYSIS OF THREE ALTERNATIVES AT THREE DISCOUNT RATES

	Description		Cost Estimates ($1,000)		Present Worth at Discount Rate ($1,000)		
Alternative	Capital	O&M	Capital	Annual O&M	4%[1]	7%[2]	10%[3]
A	Install slurry cut-off wall and ground-water monitoring system	Inspect surface conditions and monitor ground water	10,000	200	13,458	12,482	11,885
B	Install ground-water pumping and treatment system and ground-water monitoring system	Provide energy, labor, and materials to afford pumping and treatment and monitor ground water	5,000	600	15,375	12,445	10,656
C	Install ground-water pumping system and ground-water monitoring system	Provide energy, labor, and materials to afford pumping, haul water to off-site treatment facility, and monitor ground water	1,000	1,000	18,292	13,409	10,427
		Ranking[4]	C-B-A	A-B-C	A-B-C	B-A-C	C-B-A

[1] Present worth of annuity factor for 30 years = 17.292

[2] Present worth of annuity factor for 30 years = 12.409

[3] Present worth of annuity factor for 30 years = 9.427

[4] In order of lowest to highest cost.

7.4 SUMMARY OF ALTERNATIVES COST ANALYSIS

Data developed in the cost estimation and present worth analysis stages are used in a summary table to describe the alternatives (see chapter 8). Decisionmakers responsible for cost-effectiveness determinations must have a common basis for comparing costs when evaluating various remedial action alternatives. Therefore, three critical cost elements should be developed and assembled for input into the cost-effectiveness analysis: (1) total capital cost, (2) present worth costs, and (3) the cash flow over the life of the remedial action alternative.

The cash flow of a remedial action alternative presents a tally of the anticipated costs for each year of the remedial action alternative. The presentation of costs in this manner allows decisionmakers to identify and assess future capital and operation and maintenance outlays, which are important in planning budgets.

It should be noted that the presentation of the costs for each alternative should include all costs associated with implementation of the alternative. Costs common to all alternatives must be included with each alternative so that the total estimated cost for each is readily apparent.

CHAPTER 8

SUMMARIZE ALTERNATIVES

8.1 OVERVIEW

This chapter is a guide to summarizing the detailed technology, public health, environment, and cost evaluations discussed in chapters 3 through 7. The summary of alternatives is a key step in comparing the alternatives so the decisionmaker can select the cost-effective remedy in accordance with CERCLA and the NCP.

The diversity of site characteristics, the mass of information collected, and the range of factors that must be considered makes evaluating remedial alternatives and selecting one for implementation difficult. In this context, decisionmaking cannot be carried out by applying a deterministic decision rule. The decisionmaker, armed with the necessary information, must instead consider relevant and applicable standards, appropriate criteria or guidance, health and environmental concerns, technological reliability, cost, and other appropriate factors associated with each alternative. These factors must be evaluated and specific circumstances at a site must be taken into account during their evaluation.

8.2 CERCLA COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS

Chapter 4 discusses the categories of alternatives that must be examined under the "CERCLA compliance with other laws policy." The summary of alternatives must present these to the decisionmaker as well.

When the specific conditions preclude development of alternatives in one of the required categories, the feasibility study must document the reasons for that decision. Occasionally, an alternative may fall into more than one category.

The decisionmaker will consider all of the alternatives arrayed in the summary, and will give primary consideration to the remedies that attain or exceed applicable or relevant Federal public health and environmental standards. The decisionmaker would then select a remedy that attains or exceeds applicable standards unless one of the specific circumstances discussed below is determined to exist by the decisionmaker. Where relevant or applicable standards are not available or criteria or advisories are not used, the user will be directed by EPA headquarters to achieve a specific risk level or range of risk levels as described in chapter 5.

The decisionmaker may consider, and modify if necessary, criteria that were not developed for the specific application under consideration. For example, Federal Water Quality Criteria are based on consumption of 2 liters of water and 6.5 grams of fish per day. If these criteria are used for ground-water remedies, an adjustment should be made to consider consumption of water only. The decisionmaker would document cases where he/she does not use or adjust relevant standards or criteria.

If disposal of hazardous substances off-site is part of the selected response, the decisionmaker also would ensure that the off-site facility selected is acceptable under the policy in force at the time. Appendix B describes current EPA policy.

The decisionmaker may select a remedial action that includes both source control and management of migration response actions consistent with this policy.

The decisionmaker may select an on-site alternative that does not attain applicable or relevant standards in one of the following specific circumstances, recognizing that a consideration in making this determination is the extent to which the standard was intended to apply to the specific circumstances present at the site[1]:

1. The selected alternative is not the final remedy and will become part of a more comprehensive remedy;

2. All of the alternatives which meet applicable or relevant standards fall into one or more of the following categories:

    (i) Fund balancing - for Fund financed actions only; exercise the Fund balancing provisions of CERCLA section 104(c)(4);

    (ii) Technical impracticality - it is technically impractical from an engineering perspective to achieve the standard at the specific site in question;

    (iii) Unacceptable environmental impacts - all alternatives that attain or exceed standards would cause unacceptable damage to the environment; or,

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[1] In determining whether a particular standard is applicable or relevant, the decisionmaker should refer to the list of "Applicable or Relevant Requirements" in the CERCLA compliance policy. For example, RCRA did not "contemplate" the regulation of indiscriminant disposal of waste over 210 miles of roadway, or the contamination of a river bed with hazardous waste. In such situations, RCRA regulations would not be applicable per se, but on a case-by-case basis, part of the regulation may be relevant.

3. Where the remedy is to be carried out pursuant to CERCLA section 106; the Hazardous Response Trust Fund is unavailable; there is a strong public interest in expedited cleanup; and the litigation probably would not result in the desired remedy.

The Agency anticipates that most CERCLA remedial actions will attain or exceed applicable or relevant public health or environmental standards. However, where the specific circumstances discussed above preclude the selection of a remedy that attains standards, the decisionmaker would select the alternative that most closely approaches the level of protection provided by the applicable or relevant standard, considering the reasons for not meeting that standard.

8.2.1 Other Federal Environmental Standards, Guidance, or Advisories

EPA will encourage other Federal agencies to use their statutory authorities in connection with response actions. In developing remedial alternatives, the EPA should take these standards, guidance, or advisories into consideration. If an alternative is selected after consideration of these standards, guidance, or advisories but does not achieve them, the decision documents would state the reasons for the decision.

8.2.2 State Environmental Standards, Guidance, or Advisories

If a State desires the selection of a remedial action incorporating State standards more stringent than Federal standards, the decisionmaker may select that remedy. The State generally would be expected to pay additional costs incurred in achieving the more stringent standards, but the EPA decision official may make exceptions to this policy in appropriate circumstances.

8.3 ORGANIZE AND PRESENT INFORMATION

Pertinent information on costs, health risks, environmental effects, reliability, and other factors should be presented for each remedial alternative, including the no-action alternative, so that the key differences among alternatives are evident. Remedial alternatives that attain or exceed the requirements of applicable environmental regulations should be identified.

A narrative summary describing such factors as cost, technology, reliability, adverse impacts, and other factors should be used to compare all on-site alternatives to each other and to off-site disposal alternatives.

If there are not applicable or relevent Federal public health or environmental standards, the evaluation should be based on the degree to which each alternative mitigates and minimizes threats to and provides adequate protection of public health, welfare, and the environment, considering cost, technology, adverse impacts, and the reliability of the alternative.

The following information, at a minimum, must be provided for each remedial alternative:

- Present worth of total costs: The net present value of capital and operating and maintenance costs must be presented.

- Health information: For the no action alternative, EPA prefers a quantitative statement including an estimated range of maximum individual risks. For source control options, a quantitative risk assessment is not required. For management of migration measures, a quantitative risk assessment, including an estimated range of maximum individual risks, is required.

- Environmental effects: To simplify the evaluation, only the most important effects should be summarized. Reference can be made to supplemental information in a separate table, if necessary.

- Technical aspects of the alternative: This information may strongly influence the selection of a remedial alternative, and it is important to describe carefully the technical advantages and disadvantages of alternatives. Such information generally is based on the professional opinion of engineers familiar with the site and with the technologies comprising the alternatives.

- Information on the extent to which alternatives meet the technical requirements and environmental standards of appropriate environmental regulations: This information should be arrayed so that differences between the alternatives, in terms of how they satisfy such standards, are readily apparent. The kinds of standards applicable at the site may include (1) RCRA design and operating standards, (2) drinking water standards, and (3) environmental discharge standards.

- Information on community effects: The types of information that should be provided include (1) the extent to which implementing an alternative would disrupt the community (e.g., traffic, temporary health risks, and relocation) and (2) the likely public reaction.

- Information on remedies involving removal of materials for off-site disposal: This information should document compliance with EPA policy on selecting off-site EPA approved facilities for disposal of materials from CERCLA sites.

- Other factors: This category of information would include institutional factors that may inhibit implementing a remedial alternative and other important site-specific factors.

Tables 8-1 through 8-3 are examples showing how to summarize the most important information to consider in the selection of a remedy. This summary, supported by the RI/FS studies, provides the body of information the decisionmaker must use to select a cost-effective remedy. Table 8-1 lists hypothetical alternatives for source control measures at the Lehigh Electric site, and Table 8-2, for management of migration measures at the Reilly Tar site. Table 8-3 presents a hypothetical case in which both source control and management of migration measures were developed for analysis. In some cases, both source control measures and management of migration measures may be combined to form one alternative, and are presented in the table as a combined alternative. Each table describes the alternatives in terms of effectiveness, cost, and other features.

When on-site alternatives are being considered, the feasibility study will generally recommend the alternative which attains or exceeds applicable or relevant Federal public health or environmental standards except when five specific circumstances are determined to exist at the site, as required by EPA's policy on compliance with other environmental laws (described in section 8.2). In addition, appropriate Federal public health and environmental criteria, advisories, and guidance, and State standards can be used in recommending the alternative.

The summary of alternatives should highlight important differences among alternatives, reducing to manageable proportions the information to be reviewed by the decisionmaker. The summary's precision should be consistent with the extent of knowledge about the problem and the expected results of remedies.

TABLE 8-1. SOURCE CONTROL ALTERNATIVES SUMMARY FOR LEHIGH ELECTRIC

Alternative	Cost ($1,000) Capital	Cost ($1,000) Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
1. No action	10	--	PCB exposure: ingestion, inhalation, and dermal exposure to PCBs above 50 ppm.	Minimal protection for migration to aquifer and river. No contamination documented to date.	--	Unacceptable.	Landfill PCBs (Standards are 50 ppm).
2-3. Soil removal to 10 ppm, site management or capping	7,500 7,600	7,500 7,600	Assume PCBs are immobilized (no risk).	Minimal potential for migration.	--	Acceptable.	
4-6. Soil removal to 50 ppm, site management, capping, or encapsulation	6,100 6,500	6,100 6,500	Assume PCBs are immobilized (no risk).	Minimal potential for migration.		--	Unacceptable.
7. Soil removal to 50 ppm with additional excavation[a]	6,400	6,400	Assume PCBs are immobilized (no risk).	Minimal potential for migration.	—	Negotiated.	Agreement.

[a] Option selected.

TABLE 8-2. MANAGEMENT OF MIGRATION ALTERNATIVES SUMMARY FOR REILLY TAR, FIRST OPERABLE UNIT

Alternative	Cost ($1,000) Capital	Cost ($1,000) Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
1. No action	--	--	Unacceptable exposure to PAH during summer or during fires.	Continued migration of contaminated ground water.	--	High resistance.	
2. Connection to Minneapolis water system	250	8,102	Reduces public health threat to less than 10^{-6} (migration).	Does not control ground water.	Relies on simple technology.	Acceptable.	Has significantly higher O&M and present worth cost.
3. Drill deeper wells to underlying formations	1,870	2,916	Reduces public health threat to less than 10^{-6}.	Does not control continued ground-water migration. Depletes limited water resources in deeper aquifer.	Relies on proven technology.	Acceptable.	Has second highest present worth cost.
4. Aquifer treatment							
A. Ozone	376	1,618	Removes taste and odor, but results in 10^{-5} to 10^{-6} risk (2,000 ng/L for noncarcinogenic PAH)[a].	Blocks migration and allows additional wells to be opened.	Not used on wide scale. Less responsive than granular activated carbon to slug loading. Would be expensive to retrofit if treatment goals change. Certainty that target risk levels in "Public Health Concerns" column will not be consistently met is low due to operational inflexibility.	Acceptable.	Present worth is less than for GAC at low treatment level, but greater at recommended (lowest risk) level.
	459	2,109	Results in 10^{-5} to 10^{-6} risk (1,000 ng/L for noncarcinogenic PAH)[a].				
	709	2,436	Results in 10^{-6} or less risk (280 ng/L for noncarcinogenic PAH)[a].				
B. Granular activated carbon (GAC)	633	2,150	Removes taste and odor but results in 10^{-5} to 10^{-6} risk (2,000 ng/L for noncarcinogenic PAH)[a].	Blocks migration and allows additional wells to be opened.	Considered best available technology. Proven over a wide range of operating conditions. Responds well to slug loading.	Acceptable.	
	633	2,263	Results in 10^{-5} to 10^{-6} risk (1,000 ng/L for noncarcinogenic PAH)[a].		Likely to meet risk target in "Public Health Concerns" column, consistently.		
	633	24,058	Results in 10^{-6} or less risk (280 ng/L for noncarcinogenic PAH)[a].				Present worth is less at recommended treatment level.

[a] Approximate organoleptic threshold.

TABLE 8-3. SOURCE CONTROL AND MANAGEMENT OF MIGRATION ALTERNATIVES SUMMARY FOR HARD TIMES WASTE SITE

Alternative	Cost ($1,000) Capital	Cost ($1,000) Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
I. Source Control							
1. No action	10	--	Unacceptable exposure to TCE through continued release to surface water, air, and ground water. Could potentially cause excess cancer risk (direct contact with humans, unsecured areas).	Continued migration to the ground water and release to air and surface water. Could threaten endangered aquatic species.	--	Unacceptable.	--
2. Surface and subsurface removal of drums and tank, security fence	500	500	Reduces release to air and surface water. Public risk reduced (no direct contact with surface waste and contaminated areas secured).	Reduces release to air and surface water. Ground-water release continues but majority of source (above ground) is controlled. Impact to endangered aquatic species is reduced.	Proven technology.	Resisted.	Removal of waste to RCRA permitted facility. Remedial action effectiveness monitoring required.
3. Surface and subsurface removal, security fence, alternative water supply	650	9,350	Assume no direct contact or ingestion (no risk).	Reduces release to air and surface water. Ground-water release continues but majority of source (above ground) is controlled. Impact to endangered aquatic species is reduced.	Proven technology.	Moderately acceptable.	Removal of waste to RCRA-permitted facility. High O & M costs associated with alternative water supply. Effectiveness must be monitored.
4. Surface removal, capping and grading, temporary alternative water supply security fence, 360° slurry wall	2,500	3,000	Assume no direct contact or ingestion (no risk). Controls source of ground-water release.	Eliminates release to air and surface water. Impact on endangered aquatic species eliminated.	Proven technology.	Moderately acceptable.	Removal of waste to a RCRA permitted facility. The slurry wall must contain a large area because of the current ground-water plume boundaries. Effectiveness must be monitored.

(continued)

TABLE 8-3. (continued)

Alternative	Cost ($1,000) Capital	Cost ($1,000) Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
II. Management of migration							
1. No action	10	--	Unacceptable exposure to TCE through continued release to surface water, air, and ground water. Could potentially cause excess cancer risk (direct contact with humans, unsecured areas).	Continued migration to the ground water and release to air and surface water. Could threaten endangered aquatic species.	--	Unacceptable.	--
2. Pumping contaminated ground water, pretreating and discharging to local POTW, capping and grading	1,750	2,120	Assume no direct contact (less than 10^{-6}, to 10^{-7} cancer risk).	Controls existing contaminant plume in ground water.	Proven technology.	Acceptable negotiated agreement.	Must determine and meet local POTW discharge requirements and Federal 403 pretreatment regulations. Should be combined with source control measures I.2, I.3, or I.4.
3. Pumping contaminated ground water, pretreating and discharging to local surface water body, capping and grading	1,830	2,420	Reduces cancer risk to less than 10^{-5}.	Controls surface water release through capping and grading and pretreating collected ground water.	Proven technology.	Moderately acceptable.	NPDES Permit may be required. Should be combined with source control measures I.2, I.3, or I.4.
4. In situ biological and chemical treatment of contaminated soils and ground water, capping and grading, temporary alternative water supply	1,950	3,850	Results in 10^{-4} to 10^{-5} cancer risk.	Treats contaminated soils and ground water. May be concern over introducing additional chemicals and organisms to the environment through in situ treatment methodologies.	Difficult to design delivery system and to monitor effectiveness in situ treatment.	Unacceptable.	In situ treatment technology not fully developed. May have to contend with UIC requirements.

CHAPTER 9

FEASIBILITY STUDY REPORT FORMAT

This chapter presents and discusses the recommended format for CERCLA feasibility study reports. This consistent format ensures that all major issues are addressed, makes it possible to compare feasibility studies for different sites, and ensures that decisions are adequately documented. The result will be more rapid and efficient selection and implementation of the most cost-effective remedies. Table 9-1 shows the recommended format, with its numbering system, as it would appear in the report.

9.1 EXECUTIVE SUMMARY

The executive summary is a brief overview of the study and the analyses underlying the recommended remedial action. Information about the site and the feasibility analysis is summarized so that the reader can review the findings in a logical order.

The major topics addressed in the executive summary are (1) the purpose of a feasibility study; (2) the site, its background, and its problems; (3) the promising remedial action alternatives; and (4) the recommended remedial action and its advantages over other alternatives.

Discussions under each of these headings briefly convey important characteristics, criteria, and findings. Tables and figures are used where possible to summarize information clearly and concisely. The Executive Summary should be 5 to 10 pages long with at most one or two tables or figures.

9.2 INTRODUCTION

As the introduction to the report, chapter 1 briefly characterizes the site in terms relevant to the analysis of remedial action strategies. The introduction has three main topics: (1) site background information, (2) the nature and extent of contamination problems at the site, and (3) remedial objectives.

TABLE 9-1. FEASIBILITY STUDY REPORT FORMAT

Executive Summmary

1.0 Introduction

- 1.1 Site background information
- 1.2 Nature and extent of problems
- 1.3 Objectives of remedial action

2.0 Screening of Remedial Action Technologies

- 2.1 Technical criteria
- 2.2 Remedial action alternatives developed
- 2.3 Environmental and public health criteria
- 2.4 Other screening criteria
- 2.5 Cost criteria

3.0 Remedial Action Alternatives

- 3.1 Alternative 1 (No Action)
- 3.2 Alternative 2
- .
- .
- .
- 3.N Alternative N

4.0 Analysis of Remedial Action Alternatives

- 4.1 Noncost criteria analysis
    - 4.1.1 Technical feasibility
    - 4.1.2 Environmental evaluation
    - 4.1.3 Institutional requirements
    - 4.1.4 Public health evaluation
- 4.2 Cost analysis

5.0 Summary of Alternatives

6.0 Recommended Remedial Action (optional)

7.0 Responsiveness Summary (in final version only)

References

Appendices

9.2.1 Site Background Information

The site background information discussion describes the site in terms of past and present activities, concentrating on the physical, biological, and socioeconomic factors that affect site conditions. Specific topics may include the following:

- Facility location, size, existing structures
- The time period of waste-related activities
- Historical descriptions of:
  - Facility type
  - Activities and operations
  - Types of wastes
  - Condition of wastes (originally and at present)
  - Incidents that occurred (fire, explosion, ground-water contamination, etc.)
  - Site investigations, response actions, and enforcement activities
- Physiography
- Hydrogeology
- Other items
  - Community perception
  - Planned use of site
  - Conflicting or missing information
  - Site map showing location, size, water supplies, sensitive environmental areas, and nearby populations.

All discussions should be pertinent to the use of the facility for managing hazardous wastes.

9.2.2 Nature and Extent of Problems

The nature and extent of the problems at the site should be described in a way that establishes a framework for determining remedial objectives and defines criteria for selecting remedial action alternatives. This section of the introduction focuses on existing and potential on-site and off-site health and environmental effects. It should include the following:

- Type, physical state, and quantity of wastes or hazardous substances on the site
- Special waste considerations (e.g., explosive or radioactive materials)

- Present condition of materials and structures (including drums, tanks, landfills, etc.)

- Changes in site conditions (e.g., filling in a waste pit or lagoon, applying cover material to buried or partly buried drums)

- Effects of contaminants from the site (as indicated by monitoring and geotechnical studies):
  - Types of contaminant releases (e.g., leachate, runoff)
  - Affected media, movements of contaminants
  - Resources, population, or environments threatened by contaminant movement
  - Human exposure

- Near-future effects of site conditions and contaminant migration

- Actions previously taken to mitigate problems and the results of these actions.

9.2.3 Objectives of Remedial Action

The final section of the introduction identifies the objectives of remedial actions at the site. Objectives should be identified in terms of general goals (e.g., minimize off-site contaminant migration) as well as specific goals (e.g., prevent waste from coming into contact with ground water, raise site above 100-year floodplain, etc.). This section should also describe or tabulate environmental criteria and standards that form the basis for remedial actions.

9.3 SCREENING OF REMEDIAL ACTION TECHNOLOGIES

Chapter 2 of the report summarizes the screening process used to identify the most appropriate remedial action alternatives to undergo detailed analysis. Technical discussions should address the technologies initially considered and identify the most promising technologies, the methods used to develop remedial action alternatives from those technologies, and the alternatives developed. It should also discuss the problems associated with applicable technologies. The chapter should also discuss the following four categories of screening criteria:

- Environmental and public health

- Other site-related considerations such as public welfare, site access, etc.

- Cost.

The discussion should explain the reasons for eliminating certain alternatives.

The final section of the chapter identifies the most promising alternatives. Detailed descriptions and preliminary conceptual designs for these alternatives should be placed in chapter 3.

9.4 REMEDIAL ACTION ALTERNATIVES

Chapter 3 of the report summarizes the remedial action alternatives developed from the applicable technologies identified in the initial screening.

The description details the cost and noncost features of each remedial action alternative. Specific elements in these discussions should include the following:

- The intent of the remedial alternative, such as source control or mitigation of contaminant migration or effects of migration, etc.
- Key features of the alternative
    - Description of the technologies making up the alternative
- Control, storage, treatment, and/or disposal requirements
- Phasing of work, if necessary
- Special engineering, safety, environmental, public health, public welfare, or other considerations that affect the feasibility of each alternative
- Operation, maintenance, and monitoring requirements (short and long term)
- Aspects of the site problem that the alternative will or will not control.

If the alternative involves a series of separate activities, each activity should be identified and briefly described. It should also be noted whether the particular strategy provides a single-medium or multimedia solution, where such a solution is applicable. A site layout diagram, process flow diagram, and the like should be included to illustrate each alternative.

A summary of the remedial action alternatives may be included in matrix form. Such a summary would include a list of the strategies, key features of each concept, the problems to be controlled, and the expected result of each alternative.

9.5 ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

Chapter 4 of the feasibility study report presents detailed analyses of the remedial action alternatives. The majority of the analyses and supporting data will be presented in Appendices to the FS report. This chapter presents an overview of these analyses and is divided into two major sections: noncost criteria analyses and cost analysis.

9.5.1 Noncost Criteria Analysis

The noncost criteria section addresses considerations of technical feasibility, environmental protection, public health, and institutional issues. Each of these analyses is presented in a separate subsection.

For each noncost criteria category, the report summarizes the analysis performed, identifying and briefly discussing the criteria and methods used. Where possible, the results of the specific analysis for each of the alternatives should be summarized using tables and figures to consolidate comparative information. The technical discussion should concentrate on the feasibility and implementability of each alternative. The environmental discussion should assess each alternative's positive and negative impacts on the environment. The institutional discussion should discuss regulatory and community relations issues for each alternative, and their impacts on the choice of an alternative.

The final section of this chapter reviews the public health aspects of each remedial alternative, examining the relevant public health goals and public health aspects of each remedial alternative, including relevant and applicable standards, criteria, advisories, and guidance considered, and an explanation of adjustments made to standards, criteria, etc. Alternatives failing to meet these goals are noted, with brief explanations of these failures and of the anticipated effects of the level of control in question.

At a minimum, the noncost analysis of each alternative should include a discussion of the subject areas listed in section 8.3.

9.5.2 Cost Analysis

The cost analysis section should summarize the estimated costs of each alternative, review the main cost items, and discuss important considerations in the cost analysis. Cost analysis topics should include the following:

- Costing methodology
- Capital costs
- Operation and maintenance costs
- Present worth analysis
- Phasing of the work and its impact on cost (if required)

- Distribution of costs over time (stream of costs)
- Results of the sensitivity analyses.

For ease of presentation and to permit direct comparison of the various alternatives, much of the cost data should be presented in tables and figures.

9.6 SUMMARY OF ALTERNATIVES

Chapter 5 of the feasibility study report summarizes the remedial alternatives and presents the results of the analysis using appropriate summary tables and figures. The alternatives are compared, with clear statements of their advantages and disadvantages. At the end of this comparative analysis, the recommended alternative is identified, and the reasons for the selection are given.

9.7 RECOMMENDED REMEDIAL ACTION

Chapter 6 of the report, a detailed description of the recommended remedial action, is prepared to meet certain specific regional requirements. This is based on regional discretion. In some cases, the description of the recommended action will not be prepared at this stage, but after approval of the Record of Decision (ROD). Generally, for enforcement-lead sites, the Regional Administrator may elect not to include a recommended alternative at this stage.

The recommended remedial action chapter would include the following:

- A review of what the remedial action will and will not accomplish
- Special engineering considerations and special studies needed during final design
- Operation, maintenance, and monitoring requirements
- Off-site disposal needs and transportation plans
- Temporary storage requirements
- Appropriate treatment and disposal technologies
- Brief descriptions of the environmental and public health problems that may be encountered during implementation
- Means of mitigating the associated environmental and public health problems (and their costs).

9.8 RESPONSIVENESS SUMMARY

The responsiveness summary is included only in the final version of a feasibility study report, after public comment on the study. This chapter summarizes the public comment on the draft feasibility study report, including views expressed by potentially responsible parties, whether or not labelled as "comments," and actions taken regarding these comments.

9.9 REFERENCES

The references section contains the complete bibliographic citation for each information source used and cited in the main text of the report. References to sources cited in an appendix should appear in a separate list with that appendix.

9.10 APPENDICES

The text of the feasibility study report summarizes the site information evaluated and the analysis conducted in selecting the most promising remedial action alternative. So that this summary presents the major features of the analysis and decision process clearly and logically, detailed discussions, diagrams, and supporting analyses may be presented as appendices.

A feasibility study report may include the following appendices:

- Appendix A: Supporting Documentation for the Screening Process
- Appendix B: Supporting Documentation for Cost Analysis of Best Alternatives
- Appendix C: Technical Feasibility Analysis
- Appendix D: Public Health Evaluation
- Appendix E: Environmental Evaluation
- Appendix F: Exposure Analysis
- Appendix G: Institutional Analysis.

Depending on the features and problems of a site, and the complexity of the accompanying analysis, some of these appendices may be unnecessary, or additional appendices may be needed.

GLOSSARY

AASHTO - American Association of State Highway Transportation Officials

Acceptable engineering practices - technologies or practices which are technically sound, reliable, and applicable with respect to a particular site problem.

ACL - Alternative Concentration Limit

ASTM - American Society for Testing and Materials.

Budget estimates - estimates of capital operation and maintenance or service costs provided by a vendor.

CAA - Clean Air Act.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Also known as Superfund.

Cleanup - the elimination, reduction, or containment of pollutants from a site by a selected remedial action.

Community impacts - any change in the normal way of life, directly or indirectly attributable to the selected remedial action, including temporary or permanent relocation, initiation of health monitoring programs, formation of citizens' groups to review remedial alternatives, etc.

CRP - Community Relations Plan.

CWA - Clean Water Act.

Durability - the projected length of time that a designed level of effectiveness can be maintained. It is also measured in terms of the operation and maintenance requirements (parameter of reliability).

EDD - Enforcement Decision Document; a public document that is similar in purpose to a ROD. It documents the selection of a remedy and is used in settlement or litigation with potential responsible parties.

Environmental carrying capacity - the alternate uses a site is capable of supporting, especially after remedial actions.

FEMA - Federal Emergency Management Agency.

General response action - a response action category consisting of groupings of related response technologies that may be used for a specific site problem (e.g., surface water controls, air pollution controls).

HHS - Department of Health and Human Services.

HWM - hazardous waste management.

Implementability - a measure of successful prior installation of a remedial technology either on similar sites or on a research and development basis. Includes well understood installation and operational practices requiring minimal monitoring.

Institutional factors - analytical factors associated with Federal, State, and local regulations, guidance, and advisories concerning public health and welfare, environmental considerations, community relations, and other social, political, and economic concerns.

Isolation - a situation in which the transport of pollutants from a site to the surrounding environment has been stopped or slowed by the selected remedial action, but no pollutants have actually been removed.

MCL - Maximum Concentration Limit, established under to Safe Drinking Water Act.

MPRSA - Marine Protection Resource and Sanctuaries Act.

NAAQS - National Ambient Air Quality Standards.

NCP - National Oil and Hazardous Substances Contingency Plan.

NDD - Negotiated Decision Document; a confidential enforcement document containing a discussion of alternatives identified in the draft RI/FS, indicates preferred alternatives; serves as basis for negotiation with potential responsible parties.

NEPA - National Environmental Policy Act.

NESHAPs - National Emission Standards for Hazardous Air Pollutants.

NIOSH - National Institute for Occupational Safety and Health.

NOEL (No-Observed Effect Level) - the maximum experimental dose of a substance at which no toxic effect was observed.

NPDES - National Pollutant Discharge Elimination System.

NSPS - New Source Performance Standards.

O&M - operation and maintenance.

OSHA - Occupational Safety and Health Administration.

Operable unit - a discrete part of a remedial action that can function independently as a unit and contributes to preventing or minimizing a release or threat of release.

Physiography - general description of a site; for example geographic position, vegetative cover, and topography.

Present worth - a summary of costs to be incurred over a period of time discounted to the present.

PSD - Prevention of Significant Deterioration (air permit).

RCRA - Resource Conservation and Recovery Act.

Relevant or applicable standards - established Federal or State procedural requirements or limit values (such as MCLs) pertaining specifically to chemicals, environmental impacts, or technology operations conducted or anticipated at a site.

Reliability - a measure of the effectiveness and durability of a technology.

Remedial Action Alternative - a remedial technology or a combination of remedial action technologies which will prevent or mitigate site-specific contamination problems.

Remedial Action Technology ("Technology") - a general category encompassing a number of remedial action technology options that address a similar problem (e.g., capping, containment barriers, chemical treatment).

Remedial Action Technology Option ("Technology Option") - a specific process, system, or action that may be used to cleanup or mitigate contaminant problems (e.g., slurry wall, clay cap, activated sludge treatment).

REMFIT contractor - Remedial Planning and Field Investigation Teams contract to the U.S. EPA.

Risk Level - Cancer risk level provides an estimate of the additional incidence of cancer that may be expected in a population exposed to a given contaminant. A risk of 10^{-5}, for example, indicates a probability of one additionnal case of cancer for every 100,000 people exposed. A risk of 10^{-6} indicates one additional case of cancer for every one million people exposed. A risk of 10^{-7} would be one case in 10 million people exposed.

RMCL - Recommended Maximum Concentration Limit, developed under Safe Drinking Water Act.

ROD - Record of Decision, documents selection of cost-effective Fund-financed remedy.

RPM - Remedial Project Manager.

S&E Manual - procedural manual entitled "Methodology for Screening and Evaluation of Remedial Responses."

SDWA - Safe Drinking Water Act.

Sensitivity analysis - a test of a procedure to determine the overall changes that result from any small changes in one or more procedural elements.

Significant adverse impact - a public health or environmental effect that cannot be mitigated or ameliorated.

SIP - State Implementation Plan under the Clean Air Act.

Site - a landfill, surface impoundment, storage facility, or any other site or facility of any kind, at which a hazardous substance is present as a result of a release of such hazardous substance from a facility as defined under CERCLA.

SNARL - Suggested No Adverse Response Level

Social costs - perceived negative impacts resulting from a remedial action, including impacts manifested in psychological, sociological, political, legal, and organizational changes.

Technology status - the state-of-the-art, relative to application to uncontrolled hazardous waste sites, of remedial alternatives; described as proven, widely used, or experimental.

TSD - treatment, storage, or disposal facility.

UCR (Unit Carcinogenic Risk) - probability that cancer will be produced for each unit of dose.

UIC - Underground Injection Control Programs.

USDW - Underground source of drinking water.

Unit operation - the basic physical operations of chemical and civil engineering that may be applied as remedial actions, for example capping, groundwater pumping, biological treatment, containment barrier; a technology.

User - any person involved with conducting a remedial action feasibility study; the user of this document.

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APPENDIX A

MODEL STATEMENT OF WORK FOR CONDUCTING FEASIBILITY STUDIES

PURPOSE

The purpose of this feasibility study is to develop and evaluate remedial alternatives for [specific site]. The Engineer will furnish the necessary personnel, materials, and services necessary to prepare the remedial action feasibility study, except as otherwise specified.

SCOPE

The feasibility study consists of eight tasks:

Task 8 - Description of Proposed Response
Task 9 - Preliminary Remedial Technologies
Task 10 - Development of Alternatives
Task 11 - Initial Screening of Alternatives
Task 12 - Evaluation of the Alternatives
Task 13 - Preliminary Report
Task 14 - Final Report
Task 15 - Additional Requirements.

A work plan that includes a detailed technical approach, a budget, personnel requirements, and schedules will be submitted for the proposed feasibility study.

TASK 8 - DESCRIPTION OF CURRENT SITUATION

Information on the site background, the nature and extent of the problem, and previous response activities presented in Task 1 of the remedial investigation may be incorporated by reference. Any changes to the original project scope described in the Task 1 description should be discussed and justified based on results of the remedial investigation.

Following this summary of the current situation, a site-specific statement of purpose for the response, based on the results of the remedial investigation, should be presented. The statement of purpose should identify the actual or potential exposure pathways that should be addressed by remedial alternatives.

TASK 9 - PRELIMINARY REMEDIAL TECHNOLOGIES

Based on the site-specific problems and statement of purpose identified in Task 8, develop a master list of potentially feasible technologies. These technologies will include both on-site and off-site remedies, depending on site problems. The master list will be screened based on site conditions, waste characteristics, and technical requirements, to eliminate or modify those technologies that may prove extremely difficult to implement, will require unreasonable time periods, or will rely on insufficiently developed technology. [The results of this task may be requested as a separate memorandum (Remedial Options Negotiation Document) by the State or EPA.]

TASK 10 - DEVELOPMENT OF ALTERNATIVES

Based on the results of the remedial investigation and consideration of preliminary remedial technologies (Task 9), develop a limited number of alternatives for source control or off-site remedial actions, or both, on the basis of objectives established for the response.

a. Establishment of Remedial Response Objectives

Establish site-specific objectives for the response. These objectives will be based on public health and environmental concerns, the description of the current situation (from Task 1), information gathered during the remedial investigation, section 300.68 of the National Contingency Plan (NCP), EPA's interim guidance, and the requirements of any other applicable EPA, Federal, and State environmental standards, guidance, and advisories as defined under EPA's CERCLA compliance policy. Objectives for source control measures should be developed to prevent or significantly minimize migration of contamination from the site. Objectives for management of migration measures should prevent or minimize impacts of contamination that has migrated from the site. Preliminary cleanup objectives will be developed in consultation with EPA and the State.

b. Identification of Remedial Alternatives

Develop alternatives to incorporate remedial technologies (from Task 9), response objectives, and other appropriate considerations into a comprehensive, site-specific approach. Alternatives developed should include the following (as appropriate):

- Alternatives for off-site treatment or disposal, as appropriate
- Alternatives which attain applicable and/or relevant Federal public health or environmental standards
- Alternatives which exceed applicable and/or relevant public health or environmental standards
- Alternatives which do not attain applicable and/or relevant public health or environmental standards but will reduce the likelihood of present or future threat from the hazardous substances. This must include an alternative which closely approaches the level of protection provided by the applicable or relevant standards
- No action.

There may be overlap among the alternatives developed. Further, alternatives outside of these categories may also be developed, such as non-cleanup alternative (e.g., alternative water supply, relocation). The alternatives shall be developed in close consultation with EPA and the State. Document the rationale for excluding any technologies identified in Task 9 in the development of alternatives.

TASK 11 - INITIAL SCREENING OF ALTERNATIVES

The alternatives developed in Task 10 will be screened by the Engineer to eliminate those that are clearly infeasible or inappropriate, prior to undertaking detailed evaluations of the remaining alternatives.

Considerations to be Used in Initial Screening

Three broad considerations must be used as a basis for the initial screening: cost, public health, and the environment. More specifically, the following factors must be considered:

1. Environmental Protection. Only those alternatives that satisfy the response objectives and contribute substantially to the protection of public health, welfare, or the environment will be considered further. Source control alternatives will achieve adequate control of source materials. Management of migration alternatives will minimize or mitigate the threat of harm to public health, welfare, or the environment.

2. Environmental Effects. Alternatives posing significant adverse environmental effects will be excluded.

3. Technical Feasibility. Technologies that may prove extremely difficult to implement, will not achieve the remedial objectives in a reasonable time period, or will rely upon unproven technology should be modified or eliminated.

4. Cost. An alternative whose cost far exceeds that of other alternatives will usually be eliminated unless other significant benefits may also be realized. Total costs will include the cost of implementing the alternatives and the cost of operation and maintenance.

   The cost screening will be conducted only after the environmental and public health screenings have been performed.

TASK 12 - EVALUATION OF THE ALTERNATIVES

Evaluate the cost-effectiveness of alternative remedies that pass through the initial screening in Task 11. Alternative evaluation will be preceded by detailed development of the remaining alternatives.

a. Technical Analysis

The Technical Analysis will, as a minimum:

1. Describe appropriate treatment, storage, and disposal technologies.

2. Discuss how the alternative does (or does not) comply with specific requirements of other environmental programs. When an alternative does not comply, discuss how the alternative prevents or minimizes the migration of wastes and public health or environmental impacts and describe special design needs that could be implemented to achieve compliance.

3. Outline operation, maintenance, and monitoring requirements of the remedy.

4. Identify and review potential off-site facilities to ensure compliance with applicable RCRA and other EPA environmental program requirements, both current and proposed. Potential disposal facilities should be evaluated to determine whether off-site management of site wastes could result in a potential for a future release from the disposal facility.

5. Identify temporary storage requirements, off-site disposal needs, and transportation plans.

6. Describe whether the alternative results in permanent treatment or destruction of the wastes, and, if not, the potential for future release to the environment.

7. Outline safety requirements for remedial implementation (including both on-site and off-site health and safety considerations).

8. Describe how the alternative could be phased into individual operable units. The description should include a discussion of how various operable units of the total remedy could be implemented individually or in groups, resulting in a significant improvement to the environment or savings in cost.

9. Describe how the alternative could be segmented into areas to allow implementation in differing phases.

10. Describe special engineering requirements of the remedy or site preparation considerations.

b. Environmental Analysis

Perform an Environmental Assessment (EA) for each alternative. The EA should focus on the site problems and pathways of contamination actually addressed by each alternative. The EA for each alternative will include, at a minimum, an evaluation of beneficial effects of the response, adverse effects of the response, and an analysis of measures to mitigate adverse effects. The no-action alternative will be fully evaluated to describe the current site situation and anticipated environmental conditions if no actions are taken. The no-action alternative will serve as the baseline for the analysis.

c. Public Health Analysis

Each alternative will be assessed in terms of the extent to which it mitigates long-term exposure to any residual contamination and protects public health both during and after completion of the remedial action. The assessment will describe the levels and characterizations of contaminants on-site, potential exposure routes, and potentially affected population. The effect of "no action" should be described in terms of short-term effects (e.g., lagoon failure), long-term exposure to hazardous substances, and resulting public health impacts. Each remedial alternative will be evaluated to determine the level of exposure to contaminants and the reduction over time. The relative reduction in public health impacts for each alternative will be compared to the no-action level. For management of migration measures, the relative reduction in impact will be determined by comparing residual levels of each alternative with existing criteria, standards, or guidelines acceptable to EPA. For source control measures or when criteria, standards, or guidelines are not available, the comparison should be based on the relative effectiveness of technologies. The no-action alternative will serve as the baseline for the analysis.

d. Institutional Analysis

Each alternative will be evaluated based on relevant institutional needs. Specifically, regulatory requirements, permits, community relations, and participating agency coordination will be assessed.

e. Cost Analysis

Evaluate the cost of each feasible remedial action alternative (and for each phase or segment of the alternative). The cost will be presented as a present worth cost and will include the total cost of implementing the alternative and the annual operating and maintenance costs. Both monetary costs and associated non-monetary costs will be included. A distribution of costs over time will be provided.

f. Evaluation of Cost-Effective Alternatives

Alternatives will be compared using technical, environmental, and economic criteria. At a minimum, the following areas will be used to compare alternatives:

1. Present Worth of Total Costs. The net present value of capital and operating and maintenance costs also must be presented.

2. Health Information. For the no-action alternative, EPA prefers a quantitative statement including a range estimate of maximum individual risks. Where quantification is not possible, a qualitative analysis may suffice. For source control options, a quantitative risk assessment is not required. For management of migration measures, present a quantitative risk assessment including a range estimate of maximum individual risks.

3. Environmental Effects. Only the most important effects or impacts should be summarized. Reference can be made to supplemental information arrayed in a separate table, if necessary.

4. Technical Aspects of the Remedial Alternatives. The technical aspects of each remedial alternative relative to the others should be clearly delineated. Such information generally will be based on the professional opinion of the Engineer regarding the site and the technologies comprising the remedial alternative.

5. Information on the Extent to Which Remedial Alternatives Meet the Technical Requirements and Environmental Standards of Applicable Environmental Regulations. This information should be arrayed so that differences in how remedial alternatives satisfy such standards are readily apparent. The general types of standards that may be applicable at the site include:

    a. RCRA design and operating standards; and

    b. Drinking water standards and criteria.

6. Information on Community Effects. The type of information that should be provided is the extent to which implementation of a remedial alternative disrupts the community (e.g., traffic, temporary health risks, and relocation).

7. Other Factors. This category of information would include such things as institutional factors that may inhibit implementing a remedial alternative and any other site-specific factors identified in the course of the detailed analysis that may influence which alternative is eventually selected.

TASK 13 - PRELIMINARY REPORT

Prepare a preliminary report presenting the results of Tasks 8 through 13. Submit [specify number and distribution] copies of the preliminary report to EPA and the State [specify recipients]. (Note: EPA and the State will review and select a remedial alternative.)

TASK 14 - FINAL REPORT

Prepare a final report for submission to EPA and the State. The report will include the results of Tasks 8 through 13, and should include any supplemental information in appendices. This report will include a responsiveness summary on public comments received. Submit [specify number and distribution of copies] to EPA and the State [specify recipients].

TASK 15 - ADDITIONAL REQUIREMENTS

[Specified based on site-specific issues.]

APPENDIX B
PROCEDURES FOR PLANNING AND IMPLEMENTING OFF-SITE RESPONSE ACTIONS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 6 1985

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

MEMORANDUM

SUBJECT: Procedures for Planning and Implementing Off-site Response Actions

FROM: Jack W. McGraw
Acting Assistant Administrator

TO: Regional Administrators
Regions I-X

This memorandum addresses procedures that must be observed when a response action involving off-site storage, treatment or disposal of hazardous substances is selected under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and the Resource Conservation and Recovery Act (RCRA). It prohibits use of a RCRA facility for off-site management of Superfund hazardous substances if it has significant RCRA violations[1] or other environmental conditions that affect the satisfactory operation of the facility. It also addresses requirements for analyzing and selecting response actions that involve permanent methods of managing hazardous substances.

In November of 1984, amendments to the Resource Conservation and Recovery Act were enacted. These amendments impose new requirements for the safe management of hazardous wastes. In the case of land disposal facilities, the amendments require that certain types of units (new, replacement and lateral extensions) be double lined by May 9, 1985. The amendments impose technical requirements to ensure that when land disposal facilities are used they are used safely.

EPA intends to follow the direction established by Congress in the RCRA amendments when undertaking on-site response actions and when response actions involve off-site management of hazardous substances. This memorandum details how the Agency plans to achieve these goals.

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[1] A significant violation includes a Class I violation as defined by the RCRA Enforcement Response Policy (December 21, 1984). This policy defines a Class I violation as a violation that results in a release or a serious threat of release of hazardous waste into the environment, or involves the failure to assure that ground water will be protected, that proper closure and post closure activities will be undertaken, or that hazardous wastes will be destined for and delivered to RCRA permitted or interim status facilities. The policy contains a list of examples of violations which are Class I violations. Regions should recognize that violations other than Class I violations may be significant for purposes of these procedures, depending on the situation at the facility.

Section I of this memorandum discusses background issues. Section II A discusses the need to consider treatment, recycling and reuse before off-site land disposal is used. Section II B details procedures that must be followed in selecting any off-site facility for management of hazardous substances. This section also discusses the criteria to be used in making the selection. For facilities in assessment monitoring, this part states that conditions which lead to and result from being in assessment monitoring may constitute conditions that render the facility unsuitable for disposal of hazardous substances. Therefore, when a facility is in assessment, the conditions which lead to the required assessment, and any monitoring data, must be evaluated to determine if the facility poses such conditions. If so, the facility may not be used unless the owner or operator commits to correct the problems and the unit to be used for disposal poses no problems.

Section III discusses RCRA manifest requirements. Section IV discusses PCB disposal requirements. Finally, Section V details how this policy will be implemented. Attachment A is a chart summarizing the policy on use of off-site RCRA facilities. This chart should be used in conjunction with the policy document, not in lieu of it.

These procedures are applicable to all response and enforcement actions taken pursuant to CERCLA and section 7003 of RCRA.

This memorandum replaces guidance entitled "Requirements for Selecting an Off-Site Option in a Superfund Response Action", dated January 28, 1983. This policy is an interim one that the Agency intends to publish as a notice in the Federal Register in order to receive public comment on its provisions. After reviewing these comments EPA will determine whether revisions are necessary.

These revisions strengthen previous requirements in several ways:

- Coverage - This memorandum extends requirements to enforcement actions under §106 of CERCLA and §7003 of RCRA, and expands requirements for removal actions.

- Use of Treatment - These procedures require consideration of treatment, recycling or reuse for all response and enforcement actions, to foster the use of more permanent solutions, and, in the case of remedial actions, where cost-effective. The Agency is not certain whether sufficient capacity is available at this time to use treatment in all cases where it is feasible. As more information on capacity becomes available, the Agency will re-examine requirements for treatment to determine whether they can be strengthened. The previous procedures did not address use of treatment.

- Requirements for a treatment, storage or disposal facility Previous guidance required inspection within 12 months before contract award for storage, treatment or disposal. The revisions require inspection within six months of actual storage, treatment or disposal. It also stated that if a facility had deficiences that resulted in unsound treatment, storage or disposal practices it should not be used. The guidance also required RCRA violations that adversely affected facility performance to be corrected prior to contract award. Under the revisions, a facility that has significant RCRA violations or other environmental conditions that affect its satisfactory operation may not be used unless certain conditions are met. First, there must be a compliance agreement in place to correct all deficiencies at the facility; second, the unit that is used must not cause or contribute to significant problems at the facility. This provision recognizes that in some situations it is infeasible to complete correction of all violations prior to using a facility (for example, it may take several years before pumping and treating of groundwater is completed) and that there may be a unit at such a facility that is sound.

- Land Disposal Facilities - The 1984 RCRA amendments impose new requirements on land disposal facilities. When use of such facilities is contemplated, the policy requires that the facility meet these minimum technical requirements.

I. BACKGROUND

Facilities that are not in compliance with RCRA requirements may be unacceptable to use for treatment, storage or disposal of hazardous substances from response actions. Facilities used for management of substances in connection with response actions should not pose a significant threat to public health, welfare or the environment.

CERCLA contains two references to off-site management of hazardous substances. First, CERCLA section 104(c) requires, as a condition of Fund-financed remedial response, that the State assure the availability of an acceptable facility in compliance with the requirements of subtitle C of RCRA for any off-site management of hazardous substances. Second, where remedial measures include off-site storage, treatment, destruction or secure disposition, the statute also requires such measures to be more cost-effective than other remedial measures, create new disposal capacity in compliance with Subtitle C of RCRA or be necessary to protect public health, welfare or the environment from a present or potential risk which may be created by further exposure to substances. Section 300.65 (b)(6) of the National Contingency Plan (40 CFR 300) states that when off-site action is taken in connection with a removal action the facility used for off-site management must be in compliance with Subtitle C of RCRA. This memorandum establishes procedures for implementing these CERCLA and NCP provisions.

These procedures apply to all removal, remedial, and enforcement actions taken pursuant to CERCLA and section 7003 of RCRA. Any other parties undertaking cleanup under other authorities are urged to comply with these procedures. In the case of Superfund-financed removal actions or enforcement actions taken as a removal action in response to an immediate and significant threat, compliance with these procedures is mandatory unless the On-Scene Coordinator (OSC) determines that the exigencies of the situation require off-site treatment, storage or disposal without following the requirements. This exception may be used in cases where the OSC believes that the immediacy of the threat posed by the substances makes it imperative to remove the substances and there is insufficient time to observe these procedures without endangering public health, welfare or the environment. In such cases, the OSC should consider, to the extent possible, temporary solutions (e.g., interim storage) in order that the feasibility of using treatment can be evaluated prior to a decision to use land disposal. Also, in such cases, the OSC must provide a written explanation of his decision to the Regional Administrator. This explanation should be provided within 60 days of taking the action. In Regions in which authority to make removal decisions has not been fully delegated by the Regional Administrator, the decisions discussed above must be made by the Regional official that is delegated removal decision making authority.

II. PROCEDURES FOR SELECTING HAZARDOUS WASTE MANAGEMENT FACILITIES

This section discusses in detail the requirements Regions must follow in assessing and selecting an off-site RCRA facility for management of Superfund hazardous substances. Part A requires consideration of treatment, recycling or reuse for on-site and off-site actions in order to foster the use of more permanent methods of managing hazardous substances. These policies are consistent with directions taken by Congress in the 1984 amendments to the Resource Conservation and Recovery Act. Furthermore, Part B of this section establishes procedures Regions must use in selecting an off-site RCRA facility for management of hazardous substances. Where off-site land disposal must be used, this Part requires that disposal facilities be in compliance with the applicable technical requirements of RCRA.

A. Treatment

It is EPA's policy to pursue response actions that use treatment, reuse or recycling over land disposal to the greatest extent practicable, consistent with CERCLA requirements for cost-effective remedial actions. EPA requires that such alternatives be considered for all Fund-financed and private party removal and remedial actions. For Fund-financed removals or enforced actions in response to immediate and significant threats, treatment, reuse or recycling must be considered, unless the OSC determines that treatment, reuse or recycling methods are not reasonably available considering the exigencies of the situation, or they pose a significant environmental hazard.

When developing remedial alternatives, treatment, reuse or recycling must be considered. Such alternatives should not be screened out on the basis of cost alone. Section 300.68(h)(1) of the NCP allows rejection of alternatives during the screening stage based on cost, only when the cost of the alternative far exceeds the cost of others (e.g., by an order of magnitude) and does not provide substantially greater public health and environmental benefits.

Detailed analysis of these alternatives should include consideration of long-term effectiveness of treatment and comparative long and short term costs of treatment as compared to other remedial alternatives. Finally, when recommending and selecting the appropriate remedial action, treatment, reuse or recycling may be found more protective of public health and the environment than land disposal. Such alternatives may be recommended as the appropriate remedial action where the detailed analysis of alternatives shows that the alternative is more cost-effective than others in minimizing the damage to public health, welfare or the environment. During the next six months, EPA will be developing additional guidelines for evaluating the comparative long-term costs of treatment and land disposal.

At this time, the Agency does not know the current and projected treatment capacity available, nor the needs or capacity that will be required for Superfund actions in the future. Over the next several months, the Agency plans to undertake a study of available treatment and interim storage capacity and needs. Once completed, this analysis will provide information on treatment facilities currently operating for Regions to use. Additional information on capacity will be provided at a later date through a more comprehensive capacity survey being undertaken in support of the implementation of the 1984 RCRA amendments.

B. Requirements for selecting storage, treatment or disposal facilities

Selection of an appropriate facility for off-site management of hazardous substances requires that a judgment be made as to the overall acceptability of the facility to receive the substances and the acceptability of the unit that will receive the hazardous substances. In making this judgment the following steps must be observed:

1. The owner or operator of any hazardous waste management facility under consideration for off-site storage, treatment or

actions under CERCLA or section 7003 of RCRA must have an applicable RCRA permit or interim status.[2]

2. A RCRA compliance inspection must be performed at any hazardous waste management facility before it can receive hazardous substances from a response action. This inspection must assess whether there are any significant violations or other environmental conditions that affect the satisfactory operation of the facility. The RCRA compliance inspection must have taken place not more than six months prior to the storage, treatment or disposal of the hazardous substances from a response action. If the inspection has not taken place or is not scheduled, REM/FIT contractor personnel may conduct the inspection under the direction of the Deputy Project Officer, working in cooperation with RCRA Regional personnel. If Regions use contractor personnel, the Region should ensure that such personnel are adequately trained to conduct inspections. Further guidance on conducting inspections when a facility is being considered for management of hazardous substances will be issued in the near future. The FY 85 and FY 86 RCRA Implementation Plans establish compliance monitoring and enforcement targets. For FY 85 the guidance requires Comprehensive Ground-Water Monitoring Evaluations (CGMEs) at one third of the ground water monitoring facilities. Top priorities for this type of inspection are all facilities receiving wastes from Superfund sites.

In States with Phase I or II interim authorization or final authorization, the inspection should be conducted in accordance with State regulations or permit conditions. EPA Regions should always involve States when undertaking an inspection at a RCRA facility that is likely to accept Superfund wastes.

Regions must use the results from the inspection, along with other information, to determine whether the facility is an acceptable one.

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[2] Both permits and interim status apply to specific wastes and specific storage, treatment or disposal processes. The Remedial Project Manager (RPM) or OSC must determine that the facility's permit or interim status includes the wastes that would be transported to the facility and the type of process for which wastes are being taken to the facility. Because of these concerns, it is important that facility selection be coordinated with RCRA personnel. However, not all CERCLA substances are hazardous wastes under RCRA. Therefore, it is possible that a particular permit may not cover a hazardous substance that may be taken to the RCRA facility if it is not a hazardous waste. Moreover, in some situations a hazardous substance under CERCLA may trigger disposal requirements under other laws (for example, PCBs and some radioactive substances). In such cases the applicable requirements of these other laws must be observed.

3. It is EPA's policy to minimize the use of land disposal in accordance with the direction taken by Congress in amending RCRA. Where land disposal is used, these amendments establish new technical standards for land disposal facilities. New disposal units, lateral expansions and replacement units (defined as of November 8, 1984) of interim status landfills and surface impoundments must have at least two liners and a leachate detection, collection and removal system above (in the case of landfills) and between the liners, if they receive wastes after May 8, 1985. All Fund-financed and enforced response actions (removal and remedial) involving the off-site disposal of hazardous substances must involve use of disposal facilities that are in compliance with applicable RCRA minimum technical reqiurements. This means that units first receiving wastes after November 8, 1984 cannot receive wastes after May 8, 1985 if not double lined. The RCRA statute does allow continued use of existing units after that date. In considering whether to use an existing unit that does not meet the double liner requirements, the Agency will consider the toxicity, persistence and mobility of the hazardous substances and the need to segregate these substances from others. Such a unit can be used only if it is shown to adequately protect public health and the environment.

CERCLA hazardous substances which are not hazardous wastes under RCRA may, in some circumstances, be disposed of in other legal units. In such cases, disposal should take place in accordance with other legal requirements. Hazardous substances which are not hazardous wastes may be taken to a RCRA unit under the terms outlined in the preceeding paragraph, or to a unit legal under other statutory provisions (for example, PCBs may be disposed of in a TSCA approved disposal facility and radiocative materials in a radioactive materials disposal facility). This disposal must be consistent with Section 104(c)(3) of CERCLA, when applicable.

4. Interim status land disposal facilities under consideration for off-site disposal must have adequate ground water monitoring data to assess whether the facility poses a threat to ground water.[3] Due to the lack of compliance with RCRA ground water requirements, available data may not be adequate to assess the facility. Moreover, lack of evidence of contamination from the monitoring data does not necessarily mean the facility is secure. The monitoring data may be faulty. In addition, there may be other problems at the facility such as air emissions or surface run-off. Where doubt exists concerning the acceptability of a facility, an on-site inspection should be undertaken to specifically address these concerns. Where possible, this on-site inspection should be part of the required RCRA compliance inspection.

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[3] All remaining land disposal permit applications will be requested in FY 1985. These applications contain summaries of ground water monitoring data obtained during the interim status period, and are required to identify any plume contamination.

5. Using information gathered from the compliance inspection, other data sources (e.g., RCRA facility permit data), any other facility visits and all other relevant information, Regional Offices must evaluate and make a judgment on the acceptability of using the facility for storage, treatment or disposal of hazardous substances. For the facility as a whole, this evaluation should consider whether there are any RCRA violations or other environmental conditions[4] at the facility which affect its satisfactory operation. This evaluation should include consideration of facility operations as well as whether there are physical conditions at the facility that pose a significant threat to public health, welfare or the environment. For facilities in assessment monitoring, the conditions which lead to required assessment monitoring, as well as resulting monitoring data, must be evaluated. The evaluation also should consider the nature and quantity of the substances and whether it is feasible to treat the substances prior to land disposal to mitigate any adverse effects.

No Superfund hazardous substances shall be taken off-site to a RCRA facility if the Region determines that the facility has significant RCRA violations or other environmental conditions that affect the satisfactory operation of the facility, unless both the following conditions are met:

(1) The owner or operator must commit, through an enforceable agreement (i.e., consent order or decree), to correct the problem. The agreement must be signed before the facility may receive the hazardous substances. In addition, the Regional Administrator must determine that the agreement is likely to result in correction of the problem and the owner or operator of the facility is capable of compliance with the terms of the agreement; and

(2) Disposal only occurs within the facility at a new or existing unit that is in compliance with RCRA requirements. The new or existing unit must not contribute in any significant way to adverse conditions at the facility.

III. MANIFEST REQUIREMENTS

If an off-site option is chosen, a manifest for the transportation of the hazardous waste must be obtained. The manifest must r

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[4] It is recognized that the RCRA regulations may not at this time cover all environmental conditions at a facility. Regional offices may consider other environmental factors at a facility under consideration including other State and/or Federal environmental laws. If a facility is in assessment monitoring, the conditions which lead to assessment monitoring may constitute environmental conditions that adversely affect facility operations. In such cases, Regions should assess the conditions at the facility prior to using the facility for Superfund purposes.

be in compliance with RCRA for the transportation of hazardous wastes. The manifest must be a Uniform Hazardous Waste Manifest in compliance with requirements at 40 CFR 262 (see 49 FR 10490, March 20, 1984). The lead agency or other party undertaking the cleanup must ensure that the transporter properly notifies under RCRA section 3010. Where the lead agency allows contractors to fill out the manifest, the agency should ensure that the manifest is properly filed.

IV. PCB DISPOSAL REQUIREMENTS

Requirements for the disposal of PCBs are established in 40 CFR 761.60. Generally, these regulations require that whenever disposal of PCBs are undertaken, they must be incinerated, unless the concentrations are less than 50 ppm. If the concentrations are between 50 and 500 ppm, the rule provides for certain exceptions that provide alternatives to the incineration requirements. The principal alternative is disposal in an EPA approved landfill for PCBs. Landfills used for PCB disposal must be inspected within six months prior to disposal. Regions must determine the acceptability of the facility based on the same criteria used to evaluate RCRA facilities in Section II.B.5.

V. IMPLEMENTATION

Beginning (30 days from date this document is signed) all Records of Decision (RODs) and Enforcement Decision Documents (EDDs) for Superfund-lead and enforcement lead actions, respectively, must include a discussion of compliance with these procedures for alternatives involving off-site management of Superfund hazardous substances at RCRA facilities. Decision documents for removal actions also should include discussion of compliance with these procedures. It is recognized that actual offsite facility information will not be available at the ROD stage. However, the RI and FS should use actual off-site facilities in costing remedial alternatives, in order to have cost figures that are as accurate as possible. It is recognized that additional facilities are likely to be considered during the bidding process. Any facility ultimately selected for disposal, treatment or storage must meet the requirements of this policy.

Provisions requiring compliance with these procedures must be included in any contracts for response, cooperative agreements with States undertaking Superfund response and all enforcement agreements. For ongoing projects, these provisions will be implemented as follows:

RI/FS: The Regions shall immediately notify Agency contractors and States that 1) alternatives for off-site management of wastes must be evaluated pursuant to the provisions of this policy, and 2) consistent with the policy on other environmental laws, treatment alternatives should not be dropped during the screening stage.

RD: The Regions shall immediately notify Agency contractors, the States, and the U.S. Army Corps of Engineers that all remedies that include off-site disposal of hazardous substances must comply with the provisions of this policy pertaining to selection of an acceptable off-site facility.

RA: The Regions shall immediately assess the compliance status of land disposal facilities receiving hazardous wastes from ongoing projects. For a facility not in compliance, the Region should take immediate steps to bring the facility into compliance with the policy.

Enforcement: Actions currently under negotiation and all future actions must comply with these procedures. Existing agreements need not be amended. However, EPA reserves the right to apply these procedures to existing agreements, to the extent it is consistent with the release and reopener clauses in the settlement agreement (See the Interim CERCLA Settlement Policy, Part VII; Thomas, Price, Habicht; December 5, 1984).

If the response action is proceeding under a Federal-lead, the Regions should work with the Corps of Engineers or EPA Contracts Officer to negotiate a contracts modification to an existing contract, if necessary. If the response action is proceeding under a State-lead, the Regions should amend the cooperative agreement. Exceptions for existing contracts and cooperative agreements may be allowed on a case-by-case basis by the appropriate Headquarters Office Director.

All Regions must adopt procedures to implement and continually monitor compliance with these requirements. The procedures must include designation of a management official who is responsible for providing information on RCRA facilities in the Region to other Regions. It is the responsibility of the Region in which the RCRA offsite facility is located to assess the acceptability of the facility in consultation with the Region planning to ship wastes to the facility. The names of these officials should be provided to the Office of Waste Programs Enforcement by May 21, 1985. These names will then be forwarded to all Regions. If you have any questions concerning these procedures, please contact Sylvia K. Lowrance (FTS 382-4812).

Attachments

Appendix

Note.—This is an Appendix to the document and will not appear in the Code of Federal Regulations.

Memorandum

Subject: CERCLA Compliance With Other Environmental Statutes

From: Lee M. Thomas, Assistant Administrator

To: Regional Administrator Regions I–X

This memorandum sets forth the Environmental Protection Agency (EPA) policy on the applicability of the standards, criteria, advisories, and guidance of other State and Federal environmental and public health statutes to actions taken pursuant to sections 104 and 106 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This policy addresses considerations for on-site and off-site actions taken under CERCLA.

I. Discussion

The National Contingency Plan (NCP) establishes the process for determining appropriate removal and/or remedial actions at Superfund sites. In the course of this process, EPA will give primary consideration to the selection of those response actions that are effective in preventing or, where prevention is not practicable, minimizing the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health, welfare, or the environment. As a general rule, this can be accomplished by pursuing remedies that meet the standards of applicable or relevant Federal public health or environmental laws. However, because of the unique circumstances at particular sites, there may be alternatives that do not meet the standards of other laws, but which still provide protection of public health, welfare, and the environment.

Although response actions which prevent hazardous substances from migrating into the environment are seen as the most effective under CERCLA, actions which minimize migration must also be considered since CERCLA primarily addresses inadequate *post* disposal practices and resulting unique site conditions. At certain sites, it may be technically impracticable, environmentally unacceptable or excessively costly to implement a response action that prevents migration or restores the site to its original, uncontaminated condition.

II. Policy

Section 104 of CERCLA requires that for off-site remedial actions, storage, destruction, treatment or secure disposition be in compliance with subtitle C of Resource Conservation and Recovery Act (RCRA). CERCLA is silent, however, concerning the requirements of other laws with regard to all other response actions taken pursuant to sections 104 and 106. As a general rule, the Agency's policy is to attain or exceed applicable or relevant environmental and public health standards in CERCLA response actions unless one of the specifically enumerated situations is present. Where such a situation is present and a standard is not used, the Agency must document and explain the reasons in the decision documents. Federal criteria and advisories, and State standards also will be *considered* in fashioning CERCLA remedies and, if appropriate, relevant portions will be used. If EPA does not use a relevant part of these standards, criteria or advisories in the remedial action, the decision documents will state the reasons.

A. On-site Response Actions

(1) For removal actions, EPA's policy is to pursue actions that will meet applicable or relevant standards, and criteria of other Federal environmental and public health laws to the maximum extent practicable, considering the exigencies of the situation.

(2) For remedial actions, EPA's policy is to pursue remedies that attain or exceed applicable and relevant standards of other Federal public health and environmental laws, unless specific circumstances, identified below, exist.

CERCLA procedural and administrative requirements will be modified to provide safeguards similar to those provided under other laws. Application for and receipt of permits is not required for on-site response actions taken under the Fund-financed or enforcement authorities of CERCLA.

B. Off-Site Response Actions

CERCLA removal and remedial activities that involve the removal of hazardous substances from a CERCLA site to off-site facilities for proper storage, treatment or disposal must be in compliance with all applicable or relevant standards of Federal environmental and public health statutes.

Off-site facilities that are used for storage, treatment, or disposal of Superfund wastes must have all appropriate permits or authorizations.

If the facility or process that is being considered for receipt of the Superfund wastes has not been permitted or authorized, the State or responsible party will be required to obtain all appropriate permits. A State's responsibility for obtaining any appropriate Federal, State or local permits (e.g. RCRA, TSCA, NPDES, Clean Air, etc.) will be specified in a contract or cooperative agreement with the State as part of its assurances required under section 104(c) of CERCLA.

III. Federal and State Requirements That May Be Relevant or Applicable to Response Actions

Federal and State environmental standards, guidance and advisories fall into two categories:

- Federal standards that are relevant or applicable.
- Other standards, criteria, advisories or guidance to be considered.

A complete list of both categories of requirements is attached. This list is our initial effort. A revised and annotated list will be included in the forthcoming Guidance for Feasibility Studies.

A. Federal Standards That Are Relevant or Applicable

Applicable standards are those standards that would be specifically triggered by the circumstances associated with the proposed Superfund remedy except for the fact that the proposed action would be undertaken pursuant to CERCLA section 104 or section 106.

Relevant standards are those designed to apply to circumstances sufficiently similar to those encountered at CERCLA sites in which their application would be appropriate at a specific site although not legally required. Standards also are relevant if they would be legally applicable to CERCLA § 104 or § 106 actions but for legal technicalities such as trigger dates or definitions. For example, TSCA PCB standards would be relevant even though the PCBs were produced prior to January 1976, which triggers TSCA requirements.

B. Other Requirements, Advisories or Guidances To Be Considered

This category includes other standards, criteria, advisories and guidance that may be useful in developing Superfund remedies. These requirements, advisories and guidances were developed by EPA, other Federal Agencies and the States. The data underlying these requirements may be used at Superfund sites in an appropriate way.

IV. Implementation

A. Removal Actions

For both on and off-site removal actions, the On-Scene-Coordinator should consult with the Regional Response Team within the framework of the Regional Contingency Plan to determine the most effective action.

(1) *On-site.* For on-site removal actions, the OSC should attempt to *attain* all Federal applicable or relevant public health or environmental standards. The OSC also should *consider* other Federal criteria, guidance and advisories as well as State standards in formulating the removal action. However, because removal actions often involve situations requiring expeditous action to protect public health, welfare, or the environment, it may not always be feasible to fully meet them. In those circumstances where they cannot be attained, the decision documents, OSC reports, or other documents should specify the reasons.

(2) *Off-site.* Off-site facilities that are used for storage, treatment, or disposal of Superfund wastes must have all appropriate permits or authorizations.

B. Remedial Actions

1. *Presentation and Analysis of Alternatives.* As part of the feasibility study (FS), at least one alternative for each of the following must, at a minimum, be evaluated within the requirements of the feasibility study guidance and presented to the decision-maker.

(a) Alternatives for treatment or disposal in an off-site facility, as appropriate;[1]

(b) Alternativs which *attain* applicable and relevant Federal public health or environmental standards;

(c) As appropriate, alternatives which *exceed* applicable and relevent public health or environmental standards;

(d) Alternatives which do not attain applicable or relevant public health or environmental standards but will reduce the likelihood of present or future threat from the hazardous substances. This must include an alternative which closely approaches the level of protection provided by the applicable or relevant standards and meets CERCLA's objective of adequately protecting public health, welfare and environment;

(e) A no action alternative.

In some cases, there may be some overlap between these alternatives.

2. *Selection of Remedy.* The decision-maker will consider all of the alternatives arrayed in the feasibility study and will give primary consideration to remedies that attain or exceed applicable or relevant Federal public health and environmental standards. Where the selected remedy involves an EPA standard, criterion, or advisory, the decision-maker will ensure appropriate coordination with affected EPA programs.

In appropriate cases, the decision-maker may select a remedial action that includes both on and off-site components.

The decision-maker may select an alternative that does not attain applicable or relevant standards in one of the following circumstances, recognizing that a consideration in making this determination is the extent to which the standard was intended to apply to the specific circumstances present at the site.[2]

a. The selected alternative is not the final remedy and will become part of a more comprehensive remedy;

b. All of the alternatives which meet applicable or relevant standards fall into one or more of the following categories:

(i) *Fund-Balancing*—For Fund-financed actions only; exercise the Fund-balancing provisions of CERCLA section 104(c)(4);

(ii) *Technically impracticality*—It is technically impractical from an engineering perspective to achieve the standard at the specific site in question;

(iii) *Unacceptable environmental impacts*—All alternatives that attain or exceed standards would cause unacceptable damage to the environment; or

(c) Where the remedy is to be carried out pursuant to CERCLA section 106; the Hazardous Response Trust Fund is unavailable or would be used; there is a strong public interest in expedited clean up; and the litigation probably would not result in the desired remedy.

Where one of these situations is present, the decision-maker *may* select an alternative which does not attain or exceed applicable or relevant public health or environmental standards. The basis for not meeting the standard must be fully documented and explained in the appropriate decision documents.

The Agency anticipates that most of CERCLA remedial actions *will* attain or exceed applicable or relevant public health or environmental standards. However, where the specific circumstances discussed above preclude the selection of a remedy that attains standards, the decision-maker will select the alternative that *most closely approaches the level of protection* provided by the applicable or relevant standard, considering the reasons for not meeting that standard.

EPA also will use appropriate Federal public health and environmental criteria, advisories, and guidance and State standards in developing appropriate remedial alternatives. If the decision-maker determines that such standards, criteria, advisories or guideance are relevant, but are not used in the selected remedial alternative, the decision documents will indicate the basis for not using them.

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[1] These alternatives must be consistent with forthcoming guidance on "Procedures for Implementing CERCLA Delegations for Off-Site Response Actions." In some cases, off-site disposal or treatment may not be feasible and this alternative may be eliminated during initial screening of alternatives. The decision documents should reflect this screening.

[2] In determining whether a particular standard is applicable or relevant the decision-maker should refer to the attached list "Applicable or Relevant Requirements." For example, RCRA did not "contemplate" the regulation of the indiscriminant disposal of waste over 210 miles of roadway, or the contamination of a river bed with hazardous waste. In such situations, RCRA regulations would *not* be applicable per se, but on a case-by-case basis part of the regulation may be relevant.

For Fund-financed actions, where State standards are part of the cost-effective remedy, the Fund will pay to attain those standards. Where the cost-effective remedy does not include those State standards, the State may pay the difference to attain them.

3. *Administrative and Procedural Aspects.* The following modifications will be made to the Superfund community relations program to ensure that it provides a similar level of public involvement to that provided by the permitting programs of other environmental laws:

- A fact sheet should be included with the public notice and feasibility study which is provided to the public 2 weeks before the 3 week public comment period. The fact sheet will clearly summarize the feasibility study response alternatives and other issues, including which alternatives attain or exceed public health and environmental standards and criteria. For those alternatives that do not attain applicable and relevant standards of other public health and environmental laws, the fact sheet shall identify how they fail to attain the standards and explain how they nonetheless meet the goals of CERCLA. The public notice should include a timetable in which a decision will be reached, any tentative determinations which the Agency has made, the location where relevant documents can be obtained, identification of community involvement opportunities, the name of an Agency contact and other appropriate information.
- A public notice and updated fact sheet should be prepared upon (1) Agency selection of the final response action and (2) upon completion of the final engineering design. Prior to selecting the final engineering design, the Agency may hold a public meeting to inform the public of the design alternatives and solicit comments.
- If a remedy is identified that is different from those proposed during the feasibility study public comment period, a new 3 week public comment period may be required prior to amending the record of decision, taking into consideration the features of the alternatives addressed in the public comment period.

In addition, certain aspects of the CERCLA administrative process may be modified to assure comparability with the administrative requirements (i.e. recordkeeping, monitoring) of the other environmental programs.

The CERCLA enforcement community relations program will also be modified to provide for an enhanced public participation program for both consent decrees and administrative orders. This program will be substantially equivalent to the revised program for Fund-financed actions. Furthermore, consent decrees and administrative orders will incorporate administrative requirements (i.e. recordkeeping, monitoring) similar to those mandated by other environmental programs.

V. Applicability of Policy

This policy applies to three different situations:

- A site specific FS has not yet been initiated.
- The FS has been initiated, but the remedy has not yet been selected.
- The FS is completed and the remedy has been selected.

All sites where the FS has not yet been initiated must meet all of the requirements of this policy.

Where the FS has been initiated and the remedy has not yet been selected, the requirements of this policy do not apply to Record of Decisions (RODs) signed before March 1, 1985. RODs signed before March 1, 1985, should present to the decision-maker at least one alternative that attains or exceeds applicable or relevant standards and, if it is not selected should indicate the reasons why it was not selected.

Where the FS is complete and the remedy has been selected, the decision-maker may on a case-by-case basis revise the selected remedy.

If you have any questions or comments, please contact William N. Hedeman, Director, Office of Emergency and Remedial Response (FTS 382-2180) or Douglas Cohen of his Policy Analysis Staff (FTS 382-3044).

Attachment

Applicable or Relevant Requirements

1. Office of Solid Waste

- Open Dump Criteria (RCRA Subtitle D, 40 CFR Part 257)

Note.—Only relevant to nonhazardous wastes. In most situations Superfund wastes will be handled in accordance with RCRA Subtitle C requirements.

- Hazardous Waste Regulations (RCRA Subtitle C, 40 CFR Part 264) including liner, cap, groundwater, and closure requirements under the following subparts:

F. Ground-Water Protection
G. Closure and Post Closure
H. Containers
I. Tanks
J. Surface Impoundments
K. Waste Piles
L. Land Treatment
M. Landfills
N. Incinerators

2. Office of Water

- Maximum Contaminant Levels (for *all* sources of drinking water exposure).
- Underground Injection Control Regulations.
- State Water Quality Standards (apply for surface water discharge).
- Requirements established pursuant to section 301 and section 403(c) of the Clean Water Act.
- Ocean Dumping Requirements including incineration at sea.
- Pretreatment standards for discharge into a publicly owned treatment works.

3. Office of Pesticides and Toxic Substances

- "PCB Requirements including Disposal and Marking Rule (43 FR 7150, 2-17-78); PCB Ban Rule (44 FR 31514, 5-31-79) PCB Electrical Equipment Rule (47 FR 37342, August 25, 1982); Uncontrolled PCBs Rule (49 FR 28172, July 10, 1984) and other related rulemakings."
- 40 CFR 775 Subpart J—Disposal of Waste Material Containing TCDD.

4. Office of External Affairs

- Guidelines for Specification of Disposal Sites for Dredged or Fill Material (section 404(b)(1) Guidelines, 40 CFR Part 230).
- Denial or Restriction of Disposal Site for Dredged Material: Final rule (section 404(c)).

5. Office of Air and Radiation

- Uranium mill tailing rules.
- National Ambient Air Quality Standards.
- High and low level radioactive waste rule.
- Asbestos disposal rules.

6. Other Federal Requirements

- OSHA requirements.
- Preservation of scientific, historical or archaeological data.
- D.O.T. Hazardous Materials Transport Rules.
- Regulation of activities in or affecting waters of the United States pursuant to 33 CFR 320-329.
- The following requirements are triggered by fund-financed actions:
  - —Preservation of rivers on the national inventory. Wild and Scenic Rivers Act, section 40 CFR 6.302(e).
  - —Protection of threatened or endangered species and their habitats

—Conservation or Wildlife Resources.
—Executive Orders related to Floodplains (11988) and Wetlands (11990).
—Coastal Zone Management Act.

Other Requirements, Advisories and Guidance To Be Considered

1. Federal Requirements, Advisories and Procedures

- Recommended Maximum Concentration Limits (RMCLs).
- Health Advisories, EPA, Office of Water.
- Federal Water Quality Criteria.

Note.—Federal water quality criteria are not legally enforceable. State water quality standards, developed using appropriate aspects of Federal water quality criteria, are legally enforceable. In many cases, States water quality standards do not include specific numerical limitations on a large number of priority pollutants. When there are no numerical state standards for a given pollutant, Federal water quality criteria should be considered.

- Pesticide and Food additive tolerances and action levels data.

Note.—Germane portions of tolerances and action levels may be relevant in certain situations.

- Waste load allocation procedures, EPA Office of Water.
- Federal Sole Source Aquifer requirements.
- Public health basis in listing decisions under sec. 112 of the Clean Air Act.
- EPA's groundwater protection strategy.
- New Source Performance Standards for Storage Vessels for Petroleum Liquids.
- TSCA health data.
- Pesticide registration data.
- TSCA chemical advisories (2 or 3 issued to date).
- Advisories issued by FWS and NWFS under the Fish and Wildlife Coordination Act.
- National Environmental Policy Act.
- Floodplain and Wetlands Executive Orders.
- TSCA Compliance Program Policy.

2. State Requirements

- State Requirements on Disposal and Transport of Radioactive wastes.
- State Approval of Water Supply System Additions or Developments.
- State Ground Water Withdrawal Approvals.
- Requirements of authorized (Subtitle C of RCRA) State hazardous waste programs.
- State Implementation Plans and Delegated Programs Under Clean Air Act.
- All other State requirements, not delegated through EPA authority.

Note.—Many other State and local requirements could be relevant. The guidance for feasibility studies will include a more comprehensive list.

3. USEPA RCRA Guidance Documents

A. EPA's RCRA Design Guidelines

(1) Surface Impoundments, Liners Systems, Final Cover and Freeboard Control.
(2) Waste Pile Design—Liner Systems.
(3) Land Treatment Units.
(4) Landfill Design—Liner Systems and Final Cover.

B. Permitting Guidance Manuals

(1) Permit Applicant's Guidance Manual of Hazardous Waste Land Treatment, Storage, Disposal Facilities.
(2) Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, Disposal Facilities.
(3) Permit Writer's Guidance Manual for Subpart F.
(4) Permit Applicants Guidance Manual for the General Facility Standards.
(5) Waste Analysis Plan Guidance Manual.
(6) Permit Writer's Guidance Manual for Hazardous Waste Tanks.
(7) Model Permit Application for Existing Incinerators.
(8) Guidance Manual for Evaluating Permit Applications for the Operation of Hazardous Waste Incinerator Units.
(9) A Guide for Preparing RCRA Permit Applications for Existing Storage Facilities.
(10) Guidance Manual on closure and post-closure Interim Status Standards.

C. Technical Resource Documents (TRDs)

(1) Evaluating Cover Systems for Solid and Hazardous Waste.
(2) Hydrologic Simulation of Solid Waste Disposal Sites.
(3) Landfill and Surface Impoundment Performance Evaluation.
(4) Lining of Water Impoundment and Disposal Facilities.
(5) Management of Hazardous Waste Leachate.
(6) Guide to the Disposal of Chemically Stabilized and Solidified Waste.
(7) Closure of Hazardous Waste Surface Impoundments.
(8) Hazardous Waste Land Treatment.
(9) Soil Properties, Classification, and Hydraulic Conductivity Testing.

D. Test Methods for Evaluating Solid Waste

(1) Solid Waste Leaching Procedure Manual.
(2) Methods for the Prediction of Leachate Plume Migration and Mixing.
(3) Hydrologic Evaluation of Landfill Performance (HELP) Model Hydrologic Simulation on Solid Waste Disposal Sites.
(4) Procedures for Modeling Flow Through Clay Liners.
(5) Test Methods for Evaluating Solid Wastes.
(6) A Method for Determining the Compatibility of Hazardous Wastes.
(7) Guidance Manual on Hazardous Waste Compatibility.

4. USEPA Office of Water Guidance Documents

A. Pretreatment Guidance Documents

(1) 304(g) Guidance Document Revised Pretreatment Guidelines (3 Volumes).

Provides technical data describing priority pollutants and their effects on wastewater treatment processes to be used in developing local limits; describes technologies applicable to categorical industries.

B. Water Quality Guidance Documents

(1) Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (1977).

(2) Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses (1983).

Outlines methods for conducting use attainability analyses under the Clean Water Act.

(3) Water-Related Environmental Fate of 129 Priority Pollutants (1979).

Describe the transformation and transportation of priority pollutants.

(4) Water Quality Standards Handbook (1983).

Provides an overview of the Criteria Standards Program under the Clean Water Act and outlines methods for conducting criteria standards modification.

(5) Technical Support Document for Water Quality-based Toxics Control.

C. NPDES Guidance Documents

(1) NPDES Best Management Practices Guidance Manual (June 1981).

Provides a protocol for evaluating BMPs for controlling discharges of toxic and hazardous substances to receiving waters.

(2) Biomonitoring Guidance, July 1983, subsequent biomonitoring policy statements, and case studies on toxicity reduction evaluation (May 1983).

D. Ground Water/UIC Guidance Document

(1) Designation of a USDW.
(2) Elements of Aquifer Identification.

(3) Interim guidance for public participation.

(4) Definition of major facilities.

(5) Corrective action requirements.

(6) Requirements applicable to wells injecting into, through or above an aquifer which has been exempted pursuant to § 146.104(b)(4).

(7) Guidance for UIC implementation on Indian lands.

3. USEPA Manuals From the Office of Research and Development

(1) EW 846 methods—laboratory analytic methods.

(2) Lab protocols developed pursuant to Clean Water Act section 304(h).

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